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The Journal of Obstetrics and Gynaecology of the British Empire

Issued under the Direction of the Royal College of Obstetricians and Gynaecologists

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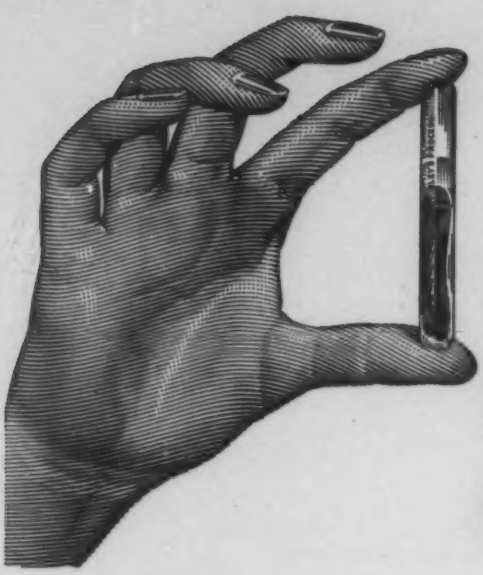
All Business Correspondence to
The Journal of Obstetrics and Gynaecology
of the British Empire
58 Queen Anne Street, London, W.1

All Editorial Correspondence to
Prof. James Young
Paynes Hill House
Steeple Aston, Oxford

VOL. LXIII, No. 1 FEBRUARY 1956 PRICE 12*s.* 6*d.* NET



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The Journal of
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VOL. LXIII, No. 1 NEW SERIES FEBRUARY 1956

THE DIFFERENCE IN BIRTH WEIGHT OF HUMAN TWINS

Twin Blood Studies: I—Oxygen Analysis of Umbilical Cord Blood

BY

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THIS study concerns the possible relationship between birth weight and foetal oxygenation in human twins.

Twin babies are often found to differ widely in birth weight. As they develop together in the same uterus of the same mother for the same length of time, it is difficult to understand why this should be.

The difference is found both in man and in animals, and is often so striking as to demand an explanation: a difference in length may also be present, but Barcroft (1946) showed in sheep that the difference in length was not so great as might be expected for the difference in weight, and concluded that there were leaner and plumper foetuses; he pointed out that this was not due to fat alone, but involved the soft parts generally.

Superfoetation, where there is fertilization of a second ovum in a woman already pregnant, might be the explanation of the very large differences in birth weight which are sometimes found, but it is still not certain that this can occur. One would expect such pairs of differing ages to differ in size and weight more than true twin pairs, and this might be evident in a distribution curve for the relative difference in birth weight of "twins".

Figure 1 shows such a distribution curve constructed from the birth weights of 304 consecutive "twin" pairs delivered in this hospital. While there is a slightly increased number of pairs where the relative difference index ranges from 16 to 24, this series alone is not large enough to be sure that the curve is bimodal. If superfoetation does occur, it probably constitutes a very small proportion of "twin" pairs.

The difference in birth weight of human twins may therefore be considered largely as two problems: one concerns monozygotic (m.z.) and the other dizygotic (d.z.) pairs; both types show marked inequality in birth weight.

Genetics can play no part in determining the different growth rates of m.z. twins, while it may be responsible for different intrinsic growth rates in the d.z. type.

Price (1950) suggests that the placental vascular communications peculiar to m.z. twins may be a cause of inequality, rather than equality, because of a unidirectional flow in the deeper arteriovenous channels. He cites the acardiac foetus, a condition peculiar to m.z. twins, as an extreme example of the influence of this vascular connexion. In this condition the development of the heart of one twin is arrested at an early stage, yet this foetus is kept alive until birth by its vascular connexion to the heart of its fellow. It seems that one twin may completely dominate the other. The increased frequency of hydramnios in one sac of m.z. twin pairs is further evidence of inequality. The differing growth rates of d.z. twins might be determined by genetic forces alone, but differences in the availability of nutriments to such pairs might also play a part.

It is common to find a "runt" in a litter of animals and this cannot be attributed to a genetic failure, unless one knows that its intrauterine environment was equal to that of the others.

Hammond (1935) found in rabbits that the

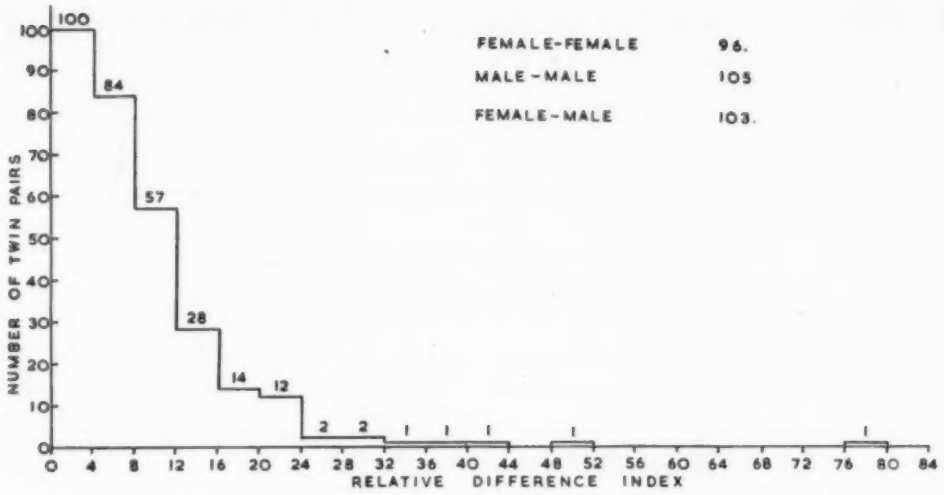

FIG. 1
Distribution graph of the relative difference in birth weight of 304 consecutive twin pairs delivered at University College Hospital.

$$\text{Relative difference index} = \frac{\text{Difference in birth weight}}{\text{Sum of birth weights}} \times 100.$$

The number of twin pairs falling within each difference index group is shown above each block.

foetuses of large litters were smaller than those of small litters. He said that was not due to overcrowding, as foetal size was not affected by the number of foetuses in one horn of the uterus.

It is true that the growth of foetuses of large litters is impaired, but the influence of number per horn has been examined in a rabbit which I killed near term. There were 9 foetuses in one horn and 4 in the other; the weights of the former were 21·8, 20·2, 18·7, 16·7, 22·8, 21·8, 21·0, 17·0 and 21·5 g., while the weights of the latter were 26·2, 26·2, 26·8 and 24·2 g. Unfortunately, such a discrepancy between the numbers in the two horns is not a common occurrence, and I have at present no other test cases, but this case alone makes one question Hammond's conclusion.

Reynolds (1949) points out that the rate of growth of large and small rabbit foetuses is similar until the last few days of pregnancy. Perhaps the sharing of a common blood supply, rather than overcrowding in the physical sense was responsible for the smaller size of the 9 in one horn. One can conceive that this might not influence the weight of the foetuses until their respiratory or other requirements exceeded the ability for vascular hypertrophy of a particular rabbit's uterine vessels.

Hammond also showed that the size of the foetus was proportional to the size of the placenta in the latter part of pregnancy; Adair and Thelander (1925) showed a similar relationship between foetal weight and placental size in the human, but Barcroft points out that this may only mean that the placenta should be considered as part of the foetus, both being affected by some common factor.

Flexner and Roberts (1940) studied the passage of radioactive sodium across the placenta in rats, and showed that the placental permeability to sodium chloride was equal for large and small litter mates. Further, Gellhorn and Flexner (1942) have shown in guinea pigs that there is a very large margin of safety in the amount of sodium transferred to the foetus over that retained by it, and gave safety factors of

500 and 65 for water and sodium respectively in late pregnancy.

Barcroft (1944) says that oxygen is the element to which the placenta seems to present the most formidable barrier, and as proof that the possibilities for the foetus of getting oxygen are almost exhausted at birth, he cites his finding that, in the rabbit, the blood emerging from the uterine vein becomes increasingly reduced as pregnancy proceeds, till, at term, it is almost devoid of oxygen. He continues by saying: "The opinion to which I am being forced is that the size of the foetus is limited largely by that of the placenta, more particularly by that of the placenta as a barrier to oxygen. What it is, however, which limits the size of the placenta is still a question."

His evidence shows that oxygen is an element which is in short supply at term, and might therefore be a factor limiting foetal growth, but the fact that the uterine vein oxygen saturation falls so low at term is evidence that almost all the available oxygen is crossing the placenta to the foetus. The bottleneck would seem to be an inadequate uterine blood supply rather than a placental barrier to the transfer of oxygen. An inadequate uterine blood supply might limit both foetal and placental development.

It is suggested that the following factors may influence the birth weight of human babies.

1. *Number of foetuses.*
2. *Maturity* (Gestation time).
3. *Genetic constitution.* Karn and Penrose (1951) have shown that boys are heavier than girls at birth.
4. *Parity of mother.* Birth weight increases with parity (Karn and Penrose, 1951).
5. *Maternal age.* Birth weight decreases slightly with maternal age (Karn and Penrose, 1951).
6. *Maternal size.* Hammond (1944) has shown, by cross-mating Shire horses and Shetland ponies, that maternal size influences the size of the foal. This is quite apart from its contribution to the genetic composition of the young.
7. *Maternal nutrition.* Clement Smith (1947) showed that small babies were born to mothers who were pregnant during the starvation period in Holland.
8. *Maternal hormones.* Diabetic mothers tend to have large babies. It has been suggested that this may be due to the diabetogenic growth factor of the anterior pituitary.
9. *Maternal metabolism.* In as much as it affects the levels of the plasma constituents bathing the placental villi.
10. *Placental permeability.* Simple diffusion.
11. *Placental efficiency.* The transfer of amino-acids to the foetus is almost certainly an active function of the placenta.
12. *Vascularity of the implantation site.*

Many of these are inter-related, but only four of the above, namely genetics, placental permeability, placental efficiency and the vascularity of the implantation site, remain for consideration in dizygotic human twins, as all the others are common to the pair.

Placental efficiency is listed separately from placental permeability, for, while some substances seem to cross the placenta by simple diffusion, there is evidence (Christensen and Streicher, 1948) that the placenta actively transfers amino-acids to the foetus.

There is as yet no evidence that placental permeability is a limiting factor; it seems probable that the placental efficiency in performing the active function of transferring amino-acids to the foetus will in part depend upon the adequacy of placental oxygenation, which in turn will depend upon the vascularity of the implantation site, so the latter may be the important non-genetic variable.

If the adequacy of the uterine vasculature were an important factor controlling foetal size, one could understand why birth weight should increase with parity. Moreover, it would explain the slight decrease in foetal weight with maternal age.

Karn *et al.* (1951) have shown that first born babies are significantly lighter than the second born sibling (for each sex); further additions to the family do not show so great a change as between the first and the second born.

Beker (1929) has shown in cows that the uterine vasculature undergoes enormous hypertrophy during the first pregnancy, and that this vascular enlargement persists to a considerable extent after pregnancy. Thus uterine vascularity may be the important difference between first and subsequent pregnancies: similarly, it may be

variations in uterine vascularity in different parts of the uterus that influence the birth weight of twins. This could apply equally to single and twin foetuses and does not presuppose any special twin factor to account for the difference.

In the present series of investigations on human twins, it is intended to study: (1) foetal oxygenation, by direct measurement of the oxygen content of the umbilical cord blood samples at birth; (2) whether the high haemoglobin level at birth, which is supposed to represent a haematopoietic response to anoxia, bears any relationship to birth weight; and (3) the measure of the relative efficiency of the placentae of twins in transferring amino-acids to the foetus.

This paper concerns the first of these investigations, namely, oxygen analysis of cord blood samples. One would like to be able to measure the oxygenation of the two foetuses undisturbed *in utero*, but this is an ideal to which one can only approximate. The present material concerns the oxygenation of twins at birth.

Method

At the delivery of each twin, the umbilical cord was digitally occluded at both ends simultaneously, before the first gasp. Spencer Wells forceps were then applied on either side of the fingers at each end, and a sealed segment of cord was isolated by cutting between the clamps. Umbilical artery and vein blood samples were then collected anaerobically over mercury in heparinized vessels from the length of cord so obtained. The oxygen contents of the four specimens from each pair of twins were estimated in duplicate by the method of Van Slyke and Neill (1924), using a 1 ml. Guest pipette for the anaerobic transfer of measured volumes to the gas analysis apparatus.

A specimen of the umbilical vein blood from each twin was used for duplicate oxygen capacity determinations.

In order that the oxygenation of twins at birth should bear any relationship to *in utero* values, it is essential that the twins should be delivered under comparable conditions.

1. The mother should either be un-anaesthetized or be breathing the same anaesthetic mixture for the birth of both twins.
2. The interval between the two deliveries should be as short as possible.

TABLE I

Showing the Results of Oxygen Analyses of the Umbilical Artery and Vein Bloods of 6 Pairs of Twins and 1 Set of Triplets at Birth

	Maturity in Weeks	Sex and Birth Order	Zygosity	Birth Weights g.	Oxygen Content		Oxygen Capacity Vols. Per cent	Oxygen Saturation		Maternal Condition and Blood Pressure Before Labour	Notes
					Umbilical Artery Vols. Per cent	Umbilical Vein Vols. Per cent		Umbilical Artery Per cent	Umbilical Vein Per cent		
A	36	1. F	DZ. DC.	2,225	7·3	16·8	22·4	33	75	Mild toxaemia.	Comparable deliveries.
		2. M		2,000	3·6	12·6	24·0	15	52	136/90. Alb. nil.	25 minutes apart.
B	40	1. M	DZ. DC.	3,550	5·3	14·9	22·9	23	65	Non-toxaemic.	1. Spontaneous vertex air.
		2. F		2,540	2·7	8·6	20·4	13	42	124/72.	2. Forceps for P.O.P. N_2O and O_2.
C	37	1. F	MZ. MC.	1,965	0·4	9·7	19·4	2	50	Toxaemic.	Twin 1: cord round neck and vasa praevia.
		2. F		2,345	4·9	11·9	19·1	26	62	140/90. Alb. trace.	Bicornuate uterus.
D	37	1. M	DZ. DC.	3,090	5·8	13·3	20·4	28	65	Mild essential hypertension.	Caesarean section under spinal block.
		2. F		2,690	2·6	8·9	20·5	13	43	120/82.	2 minutes apart.
E	40	1. F	DZ. DC.	3,070	5·2	14·3	25·3	21	56	Non-toxaemic until labour.	Post-partum hypertension, oliguria, haematuria, etc. Concealed accidental haemorrhage.
		2. F		3.120	0·2	0·6	21·5	1	3	104/70.	
F	?	1. F	MZ. MC.	2,820	0·8	6·2	19·9	4	31	Mild toxaemia.	Premature placental separation as regards twin 2.
		2. F		3,270	0·7	1·1	21·2	3	5	132/80. Alb. trace.	
G	37	1. F	2 and 3	2,490	1·8	2·7	19·6	9	14	Toxaemic.	Caesarean section under Vinesthene. 1. Breech extraction. 2. Breech extraction. 3. Version and breech extraction.
		2. F	MZ. MC.	2,140	1·1	4·8	17·3	6	28	130/80. Alb. +.	
		3. F		2,250	0·8	1·6	20·0	4	8		

MZ. MC. = Monozygotic Monochorial. P.O.P. = Persistent occipito-posterior.
DZ. DC. = Dizygotic Dichorial. Alb. = Albuminuria.

3. The presentations should both be vertex if delivered vaginally.
4. The umbilical cord should not be coiled round the foetal neck or otherwise obstructed.
5. There should be no obstetric manipulation of one twin which is not carried out on the other.
6. There should be no change in the maternal blood pressure between the two deliveries.

Although 6 pairs of twins and one set of triplets have been studied, only 2 of the twin deliveries, A and D, could be considered as having been under comparable conditions.

Results

Table I shows the results of oxygen analysis of the umbilical artery and vein blood samples, the sexes and type of the twins, and their respective birth weights.

In Figure 2 the oxygen contents and capacities of the twins are plotted against their birth weights to illustrate graphically any relationship which might exist between them, but when examining this figure one must consider the facts of each case which may have affected the results.

The twins A both presented by the vertex, and were delivered spontaneously by the vaginal route, 25 minutes apart. The mother breathed ½ per cent Trichlorethylene in air during the latter part of the first stage of labour, then air alone until the crowning of the first twin when she had a few more breaths of "trilene". She was breathing air for the delivery of the second twin.

Past experience has shown that "trilene" given in this way does not affect the oxygenation at birth, so these deliveries may be considered as having been under comparable conditions.

The smaller second born twin was less well oxygenated than its fellow, and had a higher oxygen capacity, suggesting an erythropoietic response to anoxia.

The twins B were not born under comparable conditions, as the first was born spontaneously while the mother was breathing air, and the second was delivered by forceps while the mother was anaesthetized with nitrous oxide and oxygen, which was changed to pure oxygen at delivery. Here the difference in birth weights was large, and the smaller had the lower oxygen capacity. Could it be that the first twin had been so anoxic *in utero* that both its growth and its haemopoietic response to anoxia were impaired?

The first of the twins C was born with the cord round its neck, and, moreover, was delivered through a fenestrum formed by the velamentous insertion of its own cord vessels. The second twin passed through this same fenestrum.

The twins D were delivered 2 minutes apart by Caesarean section under spinal block, while the mother was breathing pure oxygen, and the conditions at the two deliveries were as nearly comparable as possible. The smaller second born twin was the less well oxygenated, but the oxygen capacities did not differ.

The twin pairs E and F are interesting, for in both cases the blood of the second born twin was almost completely devoid of oxygen. Clearly these results bear no relationship to the *in utero* values, and it would seem that placental separation must have occurred during labour in both.

The twins E were born spontaneously with only "trilene" analgesia, the first as a breech and the second as a vertex 20 minutes later.

The mother had been quite normal during her antenatal period, but developed a hypertension of 170/110 mm. Hg during the first stage of labour; after the birth of the second child her blood pressure rose to 180/110 and she had oliguria with albuminuria followed by frank haematuria. The exact diagnosis remained uncertain, but she showed signs of severe pre-eclampsia with acute renal damage: on the 8th day post-partum she had one fit and subsequently recovered.

Both babies cried within the minute, and there was no sign of any concealed accidental haemorrhage on either of the conjoined placentae. The only explanation of these serious post-partum complications in the light of the cord blood oxygen analyses, seems to be that she did in fact have a concealed accidental haemorrhage during labour, but that being of so recent an origin it did not show as a clot on the placenta, and the severe foetal anoxia resulting from this was of so short a duration that the foetus was completely unharmed. Nevertheless the mother nearly lost her life.

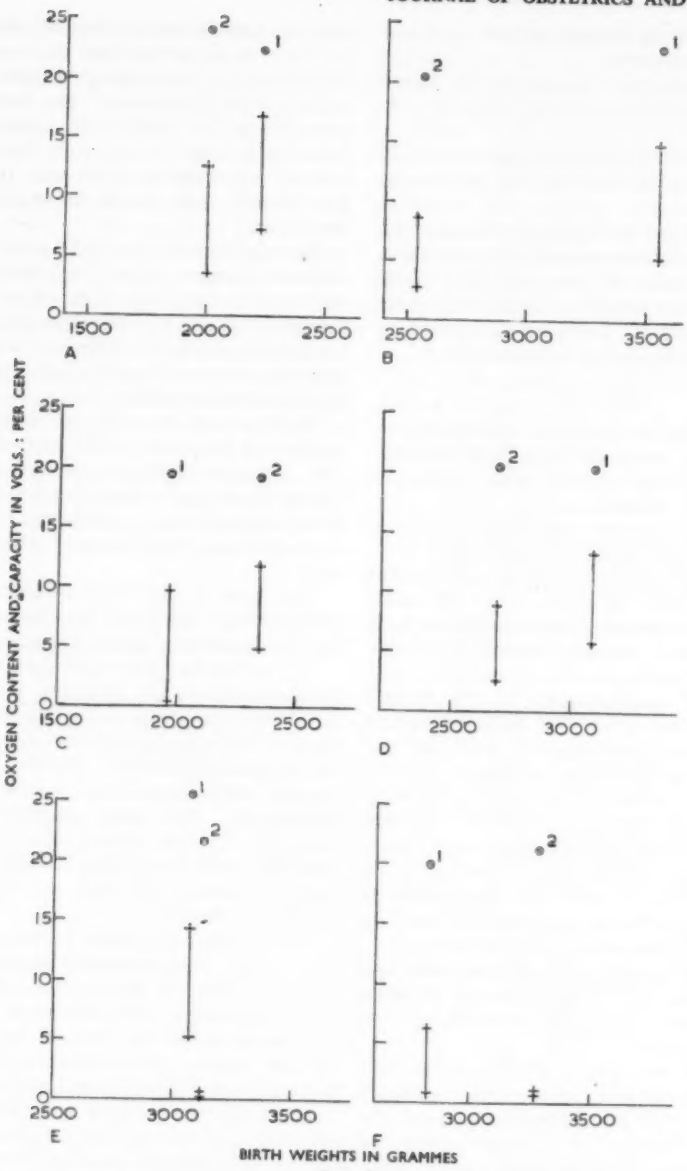

FIG. 2

In this diagram the oxygen content and capacity of blood samples collected anaerobically from the umbilical artery and vein of human twins at birth are shown against the respective birth weights of the babies. Only those samples from the twin pairs A and D were considered to have been collected under comparable conditions.

⊙ =Oxygen capacity. ↑=Oxygen content in umbilical vein blood. ↓=Oxygen content in umbilical artery blood.

The twins F were both delivered by forceps under cyclopropane and oxygen anaesthesia, and the probable cause of the anoxia of the second born was that the cord of the first was found to have been caught up in the forceps on the second head. This may have caused a premature separation of the fused placentae, but the outcome for the mother was entirely different from that of Case E. She had a perfectly normal puerperium.

These two cases illustrate the well-known fact that there are two kinds of premature placental separation, toxaemic and non-toxaemic, and the first case lends strength to Young's (1914, 1942) belief that retro-placental haemorrhage is a cause of toxaemia and not the result of it. Perhaps, as Young has suggested, partial placental separation with foetal survival allows a toxic substance to enter the maternal blood, while complete separation prevents its entry. This may explain the differing clinical pictures of the two cases.

Case E is particularly interesting in that it demonstrates how post-partum eclampsia could result from undetected intra-partum placental separation, and corroborates the views of Bartholomew *et al.* (1951) on the initiation of toxaemia during labour.

The triplets G were delivered by Caesarean section under Vinesthene, and the results of oxygen analysis of their umbilical artery and vein bloods are shown in Figure 3. They were poorly oxygenated at birth, but this is not an infrequent finding with babies born by Caesarean section, even though their mothers are kept fully oxygenated: similar results were obtained by Clemetson and Churchman (1953) in a study of single babies delivered in this way, so it is unlikely that these figures represent the true intra-uterine conditions. However, I believe it is the first reported attempt to measure the oxygenation of human triplets.

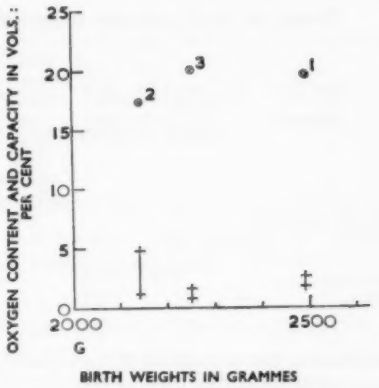

FIG. 3

Showing the results of oxygen analysis of umbilical artery and vein blood samples collected from triplets at the time of their delivery by Caesarean section.

⊙ =Oxygen capacity.
† =Oxygen content in umbilical vein blood.
↓ =Oxygen content in umbilical artery blood.

DISCUSSION

Considering only cases A and D in which conditions were considered comparable at the two deliveries, the oxygen saturation in both umbilical artery and vein of the smaller twin was lower than that of its fellow in each case.

If this difference represents a discrepancy which existed *in utero*, it might well account for the differences in birth weight.

In both cases A and D, however, it was the second born twin which was the less well oxygenated, and this was so in all the other twin deliveries, except case C, where there was cord obstruction, by cord round neck and vasa praevia, during the delivery of the first twin, which incidentally was the smaller.

Moreover, the only other oxygen analyses of human twin cord blood samples discovered in the literature, namely those of Clement Smith (1939) and of Watts *et al.* (1951) (see Table II) also show that the second born was less well oxygenated.

Thus one cannot be sure that birth order did not affect the results even in case D where the twins were delivered 2 minutes apart at Caesarean section.

This matter might be clarified by oxygen analyses at further Caesarean sections where the smaller twin is delivered first, but such material will be difficult to obtain.

SUMMARY

The cause of the difference in birth weight of twins is discussed, and it is suggested that

TABLE II

Showing the Results of Oxygen Analyses of Human Twin Umbilical Cord Bloods Reported by Others

Authors	Birth Order	Birth Weights g.	Oxygen Content		Oxygen Capacity Vols. Per cent	Oxygen Saturation		Notes
			Umbilical Artery Vols. Per cent	Umbilical Vein Vols. Per cent		Umbilical Artery Per cent	Umbilical Vein Per cent	
From Clement Smith .. (1939)	1.	—	3·0	6·4	18·3	16	35	Nitrous oxide anaesthesia.
	2.	—	0·9	3·2	19·1	5	17	4 minutes apart.
From Watts *et al.* (1951)	1.	2,270	—	10·6	19·3	—	55	1. Midforceps.
	2.	2,690	—	9·1	19·5	—	47	2. Version and extraction.

differences in the vascularity of the implantation sites of their placentae may be responsible.

The oxygen saturation of umbilical artery and vein blood samples obtained at birth from 6 pairs of twins and one set of triplets is reported.

Only 2 of the twin pairs were considered to have been delivered under comparable conditions, and in both of these the smaller twin was less well oxygenated than its fellow, but since birth order seems to interfere with the results there is no evidence that these differences existed *in utero*.

A case of *post-partum* hypertension and albuminuria followed by oliguria and frank haematuria was of special interest, in that the oxygen analyses of the blood samples from the second twin shed some light on the events during delivery which led to these severe toxaemic phenomena.

ACKNOWLEDGMENTS

I wish to thank Professor W. C. W. Nixon for his encouragement and advice, and Miss J. Churchman for technical assistance in this work.

I am also indebted to the Board of Governors of University College Hospital for making this investigation possible.

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THE DIFFERENCE IN BIRTH WEIGHT OF HUMAN TWINS

Twin Blood Studies: II—Cord Blood Haemoglobin Levels

BY

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IN a previous paper it has been suggested that oxygen may be the limiting factor which is responsible for the difference in birth weight of human twins. It is known that "blue babies" with congenital heart disease do not grow as fast as normal babies, and that vascular impairment in a child's limb arrests the growth of that limb, so it is possible that a foetus whose placenta is implanted in a less vascular part of the uterus might grow more slowly than its twin situated more favourably.

In order to test this hypothesis, it is necessary to know the oxygenation of twins *in utero*, but one can only study them at birth, and the results obtained at this time are influenced by various incidents of delivery.

One therefore requires some index of intra-uterine oxygenation, which is less likely to be influenced by delivery.

Barcroft (1946) has shown that there is an inverse relationship between the oxygen content of the umbilical artery and the oxygen capacity of the foetal blood of the ewe; he quotes Anselmino's suggestion that the high haemoglobin level of babies at birth is a compensation for the anoxia of intra-uterine life, and compares it with acclimatization to high altitudes (see also Eastman, 1930).

If the haemoglobin level at birth is to be used as an index of the degree of anoxia experienced by foetuses *in utero*, it is essential that this value should be unaffected by maternal anaemia or any other maternal factors. Fortunately, this question does not concern the differences of haemoglobin levels in twins, and it would seem that the values might serve as a comparative measure of anoxia between the two.

Admittedly, certain other factors may interfere with the haemoglobin level at birth, notably Rh iso-immunization, A.B.O. iso-immunization, (Weisl, 1948), and in certain cases intra-uterine foetal haemorrhage (Weiner, 1948).

Mollison and Cutbush (1949) pointed out the errors due to measuring a baby's haemoglobin level 24 hours after birth; comparing cord blood samples at birth with venous samples taken 24 hours later they showed that a true anaemia at birth may be masked at 24 hours, because of the differing amounts of placental blood drained into the baby when the cord is clamped early and when it is clamped late. Another factor in this masking of anaemia in the newborn may be a true haemo-concentration due to a negative fluid balance which is the rule during the first 24 hours.

Further, Oettinger and Mills (1949) have shown that in most infants during the first week of life the haemoglobin content of capillary blood from the heel exceeds that of simultaneous venous samples, the range of difference varying from 0·6 to 8·2 g./100 ml. This presumably means that the blood in the skin venules of the heel lies stagnant and is not circulating.

The resultant of all these factors occurs in heel bloods 24 hours after birth, and was demonstrated by the present writer in a case of twins born with cord haemoglobin levels of 18·7 g. (126 per cent) and 13·2 g. (89 per cent) whose heel blood haemoglobin levels 24 hours later were 21·3 g. (144 per cent) and 19·8 g. (134 per cent) respectively.

For these reasons only cord blood haemoglobin estimates have been used in the present investigation.

TABLE I

Showing the Cord Haemoglobin Levels of 35 Twin Pairs and 2 Sets of Triplets, with Their Birth Weights and Placental Weights

	Case No.	Maturity in Weeks	Sexes	Placental Weights		Placentae Fused or Separate	Birth Weights		Relative Difference in Birth Weight	Cord Haemoglobin Levels	
				Twin 1 g.	Twin 2 g.		Twin 1 g.	Twin 2 g.		Twin 1	Twin 2
										Per cent	Per cent
						Monochorial Twin Pairs					
	9	37	M. M.	1,370		Fused	2,720	3,150	7·3	116	111
	12	37	F. F.	830		Fused	1,965	2,345	8·8	113	109
	19	37	M. M.	1,160		Fused	2,950	2,490	8·5	121	117
	23	36	F. F.	610		Fused	1,280	1,670	13·2	130	148
	25	?	F. F.	1,150		Fused	2,820	3,270	7·4	110	119
						Dichorial Twin Pairs					
A	Those whose birth weights differed relatively little:										
	11	40	F. F.	1,120		Fused	3,070	3,120	0·8	130	119
	18	36	F. M.	490	480	Separate	2,380	2,410	0·6	122	120
	21	35	F. M.	340	330	Separate	2,090	2,110	0·5	141	121
	28	38	F. M.	440	350	Separate	2,490	2,490	0·0	134	129
B	Those where the smaller twin had the higher cord haemoglobin level:										
	1	43	F. M.	490	550	Fused	2,550	3,050	8·9	137	128
	2	35	F. M.	400	420	Fused	1,670	2,490	19·7	126	89
	3	22	F. F.	400		Fused	560	485	7·2	67	84
	4	38	M. F.	490	440	Separate	2,720	2,860	2·5	110	97
	5	41	F. F.	620	560	Fused	3,150	2,860	4·8	116	126
	6	38	F. M.	1,175		Fused	3,130	2,750	6·5	112	120
	7	35	M. M.	310	450	Separate	2,100	2,200	2·3	127	114
	8	38	F. M.	450	500	Fused	3,175	3,440	4·0	121	108
	10	36	F. M.	420	350	Separate	2,225	2,000	5·3	123	129
	14	37	M. F.	580	440	Separate	3,090	2,690	6·9	111	120
	20	38	M. M.	400	200	Separate	2,290	1,670	16·8	108	122
	24	45?	F. F.	770		Fused	2,030	2,480	9·9	126	113
	31	34	M. F.	720	320	Separate	2,650	1,570	25·6	123	132
	32	38	M. F.	500	370	Fused	3,150	2,320	15·2	110	130
	34	38	F. M.	530	390	Separate	2,960	2,790	3·0	110	118
	35	38	F. F.	850		Fused	2,410	2,810	7·7	119	102
C	Those where the larger had the higher haemoglobin level:										
	13	40	M. F.	700	480	Fused	3,550	2,540	16·6	125	115
	15	39	M. M.	450	270	Separate	2,770	1,815	20·8	147	130
	17	40	F. M.	?		Fused	2,550	2,665	2·2	126	149
	22	36	F. M.	270	392	Separate	1,700	2,410	17·3	122	133
	30	36	F. F.	850		Fused	2,420	2,120	6·6	140	135
D	Those where the cord haemoglobin levels did not differ by 5 per cent:										
	16	40	F. F.	340	350	Separate	2,130	1,810	8·1	128	125
	26	33	M. F.	760		Separate	1,910	1,820	2·4	131	132
	27	41	M. M.	750		Fused	2,330	1,840	11·8	128	128
	29	39	M. M.	900		Fused	3,910	3,600	4·1	119	119
	33	40	F. F.	590	590	Separate	2,615	1,915	15·5	145	145
						Triplets					
	A	41	M.	600		Fused	2,430			102	
			M.				2,550			93	
			F.	320			2,215			115	
	B	37	F.	440		Separate	2,490			111	
			F.	650		Fused	2,140			97	
			F.				2,250			113	

The dichorial twins are grouped according to the relationship between their haemoglobin levels and their birth weights.

The "Relative difference in birth weight" signifies: $\frac{\text{The difference in birth weight}}{\text{The sum of the birth weights}} \times 100$.

The haemoglobin levels are given as percentages and each represents the mean of 10 readings on a Grey Wedge Photometer. On this instrument 100 per cent represents 14·8 g. of haemoglobin per 100 ml.

Methods

An umbilical cord blood sample was withdrawn from the umbilical vein of each twin at the moment of birth with a dry sterile syringe. These samples were immediately transferred into bottles containing 500 Toronto units of dry heparin. One ml. of each was then diluted to 200 ml. in 0·04 per cent ammonia solution using a dry pipette calibrated to contain 1 ml.; the blood adhering to the wall of the pipette after use was washed out with diluting fluid into the 200 ml. flask for making up of the diluted specimen.

The oxyhaemoglobin contents of these diluted specimens were estimated on the M.R.C. Grey Wedge Photometer, the mean of 10 readings being taken as the final result. On this instrument 100 per cent is equivalent to 14·8 g. of haemoglobin per 100 ml.

King *et al.* (1948) found that no estimate on this type of haemoglobinometer was more than 5 per cent from the true value. However, by taking the mean of 10 readings a greater accuracy is obtained. The haemoglobin levels of the twin bloods in this investigation are said to differ when the means are 5 per cent or more apart.

Results

Thirty-five pairs of twins and 2 sets of triplets have been studied in this way, and their haemoglobin levels are shown in Table I.

They have been classified simply as mono- or dichorial by inspection of the membranes, but their zygosity is not recorded, as sub-type blood grouping was only available for some of the later like-sexed pairs.

The relative difference in birth weight of each pair may be expressed as the difference in birth weight divided by the sum of the birth weights. This has been multiplied by 100 to give whole numbers, and as shown in Table I it then ranges from 0 to 25·6 in this series.

Among the 30 dichorial twin pairs, there were 4 in which the birth weights did not differ sufficiently to bring this figure above unity. (See Fig. 1(*a*).)

Those dichorial twins whose relative difference in birth weight was greater than this comprised:

16 where the smaller twin had the higher Hb level (Fig. 1(*b*)).

5 where the smaller twin had the lower Hb level (Fig. 1(*c*)), and

5 where the Hb levels did not differ by 5 per cent (Fig. 1(*d*)).

The 5 monochorial twin pairs comprised:

1 where the smaller twin had the higher Hb level,

2 where the smaller twin had the lower Hb level, and

2 where the Hb levels did not differ by 5 per cent.

Considering each set of triplets as three pairs 1–2, 2–3, and 1–3, each set has one monochorial and two dichorial pairs. In one set all three pairs showed the smaller to have the higher level, while the other set did not show this relationship at all.

Red cell counts and haemoglobin estimates have been carried out on a number of cases in an attempt to discover how the differences in the haemoglobin levels of twin bloods arise: whether the higher haemoglobin level is due to a greater number of red cells, to larger cells, or to a greater haemoglobin concentration in similar sized cells.

However, the accuracy of the results of the red cell counts and haematocrit estimations are not so great as those of the haemoglobin estimations, and for this reason no reliable information could be obtained concerning the nature of small differences in haemoglobin levels.

The results of one such investigation in a twin pair (No. 31), where the birth weights differed by more than a kilogram and the blood pictures were also markedly different, is shown in Fig. 2. Here, the smaller twin which had the higher haemoglobin level was found to have larger paler cells than its fellow, but one does not know whether this is always so.

The birth weights and placental weights in Table I show that, as a rule, where the placentae are separate or can be separated, the smaller twin has the smaller placenta. This also was best illustrated by Case 31 where the birth weights differed so much, and Fig. 3 shows that the placenta of the smaller twin was less than half the weight of that belonging to the larger twin.

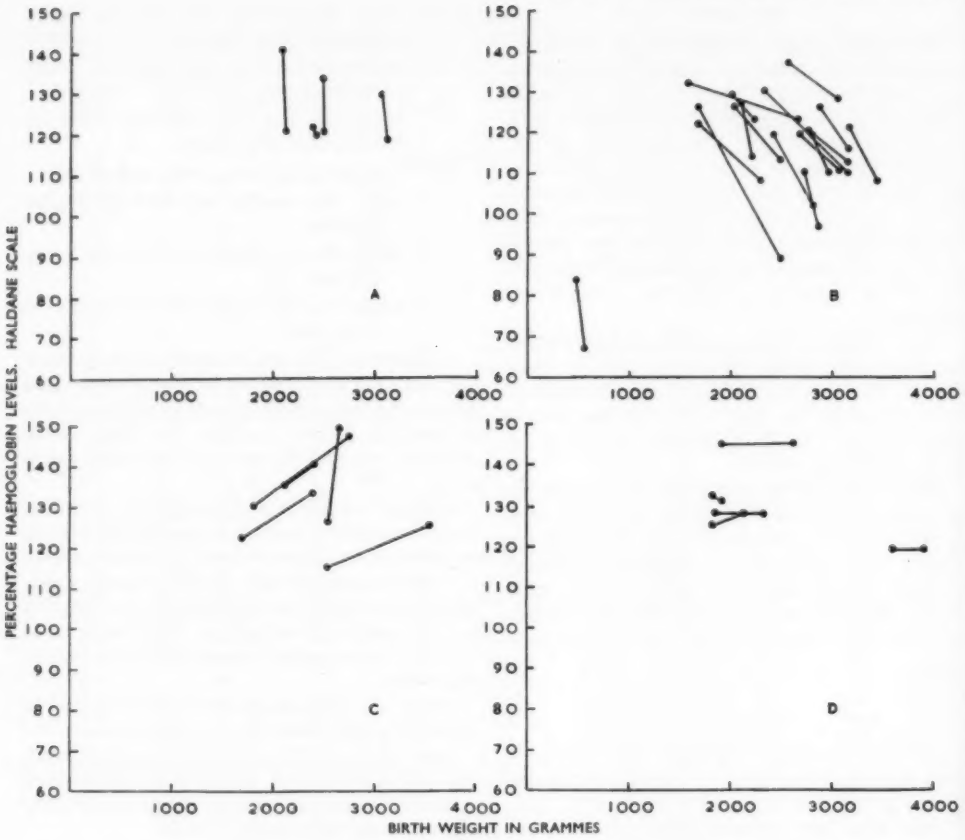


FIG. 1

Showing the umbilical cord blood haemoglobin levels of 30 dichorial human twin pairs at birth, plotted against their birth weights.

The twins have been divided into four groups:

A. Those whose birth weights did not differ sufficiently to give a *relative birth weight difference index* of more than 1 (4 pairs).
B. Those where the smaller twin had the higher haemoglobin level (16 pairs).
C. Those where the larger twin had the higher haemoglobin level (5 pairs).
D. Those where the haemoglobin levels did not differ by 5 per cent Haldane (5 pairs).

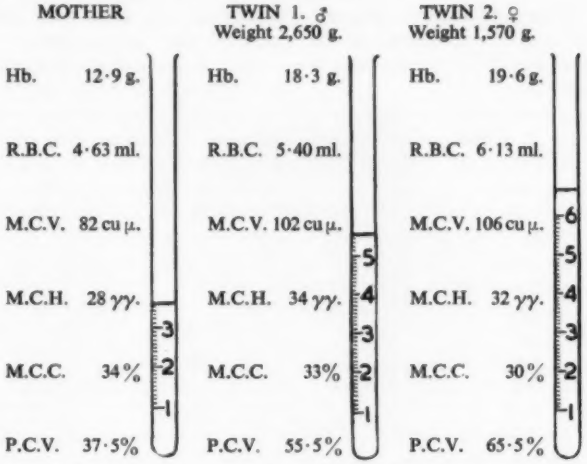
It will be seen that there is a preponderance of those pairs where the smaller (i.e., lighter) had the higher haemoglobin level.

DISCUSSION

A surprising feature of this investigation was the finding of differences in the haemoglobin levels of monochorial twin pairs, whose blood is supposedly in communication until birth.

How quickly mixing of the two bloods takes place across the placental vascular communications, is not known, but the existence of communications is beyond dispute as they are sometimes clearly visible on the foetal surface of the placenta, as in Cases 19 and 25.

The differences in haemoglobin levels at birth in such cases would therefore seem to be connected with the incidents of delivery, yet no



Cord blood specimens taken with dry sterile syringes by needling the umbilical vein at each delivery. Maternal venous sample taken by needling antecubital vein between the two deliveries.

The drawings show the greater packed cell volume of the blood of the smaller second born twin, and it can also be seen that this was associated with an increased haemoglobin level and red cell count.

The M.C.V., M.C.H., and M.C.C. show that the smaller twin also had larger paler cells than its fellow.

FIG. 2

Showing the absolute red cell indices of blood from a pair of twins (No. 31) and their mother at the time of birth.

relationship is found between birth order and haemoglobin level either in the monochorial or the dichorial type. It may be that intra-partum asphyxia causes haemo-concentration, for exceptionally high haemoglobin levels are found in such cases.

Considering the dichorial twin pairs, there is a statistically significant tendency for the smaller twin to have a higher cord haemoglobin level than the larger.

This may mean that the smaller twin is smaller because it was less well oxygenated *in utero*, the higher haemoglobin level being an erythropoietic response to anoxia. Another explanation, however, is that each twin receives the same amount of haemoglobin-forming material, and that the larger twin outgrows its requirements.

If the difference in birth weight of twins were due to differences of gestational age, as by superfoetation or superfecundation, the larger and more mature foetus would have the higher cord haemoglobin level, rather than the reverse which has been found more frequently in this investigation, because the haemoglobin level rises as foetal age advances.

Barcroft (1946), considering single sheep foetuses, stated that the heavier the foetus the higher the haemoglobin level, but this must be an effect of time, because when gestation time is constant, as in twins, the reverse seems to be the rule.

Barcroft's explanation of the rise in haemoglobin level with foetal age is not disputed, for he has shown that the foetal oxygen requirements are becoming greater than the mother can meet towards term and the oxygen saturation of the carotid blood of the foetus is steadily falling. There may, however, be a partial safeguard, if foetal growth is slowed by oxygen want.

Hurtado, Merino and Delgado (1945) showed a similar rise in the haemoglobin level in residents at high altitudes in the Peruvian Andes.

In general the level of the polycythemic response was directly proportional to the degree of the anoxic stimulus, but they found there was a limit to this response.

A fall, rather than a further rise in the haemoglobin level, occurred in miners with silicosis when the oxygen saturation of their arterial blood fell below 60 per cent.

It is conceivable that the foetus also might experience such a failure of the erythropoietic response if its oxygenation became seriously impaired. Thus, erythropoietic failure from extremely poor oxygenation, or, on the other hand, superfoetation, might be put forward as explanations of the anomalous results in the 5 cases where the smaller twin had the lower haemoglobin level.

In this respect it is interesting that 3 of the 5 dichorial twin pairs where the larger had the higher haemoglobin level showed a relative birth weight difference index between 16 and 24. This is the range where it was suggested in the preceding article that superfoetation might occur; this is in contrast to an incidence of only 3 out of 16 in this index range among those where the smaller twin had the higher haemoglobin level.

Superfoetation may have occurred in Case No. 13 where the larger placenta was found to be overlapped by the smaller one, as if the latter were a late arrival. The most likely cause, however, of the higher haemoglobin level of the larger twin in the other 4 cases was haemoconcentration due to intra-partum asphyxia; 2 of them (Nos. 15 and 30) were stillborn, and the other 2 (Nos. 17 and 22) showed delay in the onset of respiration following a breech extraction and a forceps delivery respectively.

Seward (1950) has shown that the blood picture of the newborn may be affected by long labour, and he has also pointed out that the oxygenation of the foetus may be reduced when the commonly used 50 per cent nitrous oxide and air anaesthesia is given to the mother, so these factors may have influenced the haemoglobin levels in some cases.

The majority of the twin mothers had trilene analgesia, but some had varying mixtures of nitrous oxide and oxygen.

One must conclude that, although the haemoglobin levels of individual twin pairs at birth are liable to be affected by incidents during delivery, a consideration of the whole series of dichorial twins does show a significant tendency for the smaller twin to have the higher haemoglobin level. If this represents an *in utero* difference, it may mean that the smaller twin was less well oxygenated *in utero*.

Summary

The umbilical cord blood haemoglobin levels of 35 pairs of twins and 2 sets of triplets have been estimated by the M.R.C. Grey Wedge Photometer.

Differences are found in the cord haemoglobin levels of monochorial twins at birth, where placental vascular communications make it seem unlikely that differences existed *in utero*. This suggests that intra-partum factors influence the results.

Nevertheless, there is a significant tendency in dichorial pairs for the smaller (lighter) twin to have the higher haemoglobin level. If this is an *in utero* difference, it may mean that the smaller twin is smaller because it was less well oxygenated *in utero*.

Acknowledgments

I wish to express my gratitude to Professor W. C. W. Nixon and to the Board of Governors of University College Hospital for making this investigation possible.

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FIG. 3

Twin 1. Male: birth weight 2,650 g.: placental weight 720 g.
Twin 2. Female: birth weight 1,570 g.: placental weight 320 g.
Showing a heterozygous-dichorial twin pair (No. 31) with their placentae soon after birth.
There was more than a kilogram difference between the birth weights and, as is usual, the smaller twin had the smaller placenta.
The absolute red cell indices of cord blood samples from this pair are shown in Fig. 2.

FIG. 4

Showing the same twins as in Fig. 3, when 6 months old. The boy who weighed 5 pounds 13½ ounces at birth now weighs 16½ pounds, and the girl who weighed 3 pounds 7½ ounces at birth now weighs 14½ pounds.

It is evident that there was no intrinsic genetic weakness in the female foetus, for she developed just as well as her twin brother after birth.

THE DIFFERENCE IN BIRTH WEIGHT OF HUMAN TWINS

Twin Blood Studies: III—Placental Transfer of Amino-acids

BY

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RECENT investigations have shown conclusively that the amino-acid level of human foetal plasma is consistently higher than that of the mother (Christensen and Streicher, 1948; Crumpler, Dent and Lindan, 1950).

Amino-acids therefore cannot reach the foetus by simple diffusion across the placental barrier, and there is reason to believe that the placenta actively transfers them to the foetus.

Bonsnes (1947) found that the human plasma free alpha-amino-nitrogen level is lower during pregnancy (average 3·2 mg./100 ml.) from the 9th week until term, than in the non-pregnant subject (average 4·3 mg./100 ml.), and there is evidence that this low level of pregnancy is due to the active transfer of amino-acids to the foetus (Clemetson and Churchman, 1954).

These findings raise several questions with regard to twins. Firstly, if the ratio which the foetal level bears to the maternal level is a measure of placental efficiency, does this ratio differ in twins? If so, is it related to the difference in birth weight of twins? Secondly, if the presence of one foetus lowers the maternal level from 4·3 mg./100 ml. to 3·2 mg./100 ml., do twins lower it still more? Is there any relationship between the maternal level and the birth weights of the twins?

Burke, Harding and Stuart (1943) showed a relationship between the birth weight and length of babies and the protein intake of their mothers during pregnancy. However, whole protein cannot pass the placental barrier in more than antigenic trace quantities, if at all, so it would seem that the maternal amino-acid level and the ability of the placenta to transfer the amino-acid constituents of the protein molecule might be crucial factors in determining birth weight.

In a study of the placental transfer of amino-acids of single foetuses, no relationship was found between birth weight and either the foetal or the maternal amino-acid level, but this was only to be expected in view of the factors such as umbilical cord obstruction and toxaemia of pregnancy, which were found to influence the maternal level; it seemed that twins would provide the ideal material for a study of a possible relationship between this placental function and birth weight, since the placentae of both foetuses have the same maternal environment for the same length of time, and it is only the foetal amino-acid levels which would vary as a result of differences in placental efficiency.

METHODS

Three blood samples were used for the study of each set of twins, and these were collected at vaginal twin deliveries.

A foetal sample was collected by syringe from the umbilical vein of each twin at birth and was transferred to a bottle containing 500 Toronto units of dry heparin. A maternal blood sample was collected from the antecubital vein immediately after the birth of the second twin and was heparinized in the same way. The three blood samples were centrifuged as soon as possible, usually within the hour, and the specimens of plasma were stored at minus 10° C. until analysis. Any set in which a sample showed haemolysis was discarded.

Free plasma alpha-amino-nitrogen estimations were carried out by the ninhydrin manometric CO_2 method of Hamilton and Van Slyke (1943). One ml. of plasma was used for each estimation.

The placentae were identified after delivery

by a ligature on the umbilical cord of that belonging to the first twin, and were classified as mono- or dichorial by discovering whether or not the membranes between the two sacs would strip back to the cord insertions. If only two layers of amnion separate the two sacs, these may be stripped up from the foetal surface of the placenta, while, if two layers of chorion are also present, there is a line of demarcation between the foetal surface of the placentae from which the chorion cannot be stripped without tearing.

The zygosity of the twins was decided in the first place by their sex and, where the sexes were the same, by blood grouping, skin creases and other physical features.

The 16 twin pairs in this study are classified as monozygotic monochorial (MZ. MC.) or dizygotic dichorial (DZ. DC.). Unfortunately none of these pairs was of the more useful monozygotic dichorial variety.

Results

Table I shows the results of duplicate analysis of 8 sets of samples; it is evident from these that real differences do exist in the plasma-amino-nitrogen levels of twins at birth, even in MZ. MC. pairs. Whether these differences existed *in utero* is another matter.

Table II shows the results of analysis of a further 8 sets of samples, on which duplicates were not obtained for one or other of the three samples.

The mean maternal plasma alpha-amino-nitrogen level of the 16 cases was 3·35 mg./100 ml. This is higher than the mean level of 2·96 mg./100 ml. found by Clemetson and Churchman (1954) in normal mothers bearing single foetuses, but falls within the range found in mothers with toxaemia of pregnancy or umbilical cord obstruction during delivery.

Since toxaemia of pregnancy was present in 6 of the twin mothers, and cord obstruction by breech delivery or cord round neck was present in one or other twin of 6 other pairs, it would seem that there is no real difference between the levels in single and twin bearing mothers.

No relationship was found between the maternal level and the sum of the birth weights of her twins.

The mean 1st twin level was 4·84 mg./100 ml., and the mean 2nd twin level was 5·14 mg./100 ml. These are within the range found in single babies.

The foetal/maternal ratios of each pair are shown in the tables, but these were not found to be related to the birth weights of the twins. In 10 cases the smaller twin had the higher level, and in 6 cases the larger had the higher level.

Considering birth order and foetal levels, the mean value of the difference (2nd twin level less 1st) for each pair was 0·30 mg./100 ml. which is not significantly different from zero. However, 13 of the 16 cases showed the 2nd twin to have the higher level, and this does suggest that the results may be influenced by birth order.

Discussion

Three of the twin pairs were of the MZ. MC. variety, and in 2 of them (Nos. 19 and 25) vein–vein or artery–artery communications between the circulation of the twins were clearly visible on the foetal surface of the placenta. There may also have been deeper capillary arteriovenous connexions between the villi of the two placental halves in all 3 MZ. MC. pairs as described by Schatz (1887).

One would, therefore, have expected to find identical foetal plasma levels in each of these 3 pairs. The fact that they differed might be interpreted as evidence favouring the theory of unequal gradients of various nutriments put forward by Price (1950) as a possible result of unidirectional flow in the artery–vein anastomoses of MZ. MC. twins.

The tendency for the second born twin to have the higher level, however, suggests that the results do not represent *in utero* conditions, but are dependent on some change which occurs during the time between the two deliveries. This time varied from 8 to 85 minutes in the cases studied, but no relationship was found between the duration of this delay and the difference in the levels.

If placental impairment occurred during labour, or if the second twin suffered premature placental separation as sometimes happens, one would expect the second born twin to have the lower level. It may be that the birth of the first twin allows the maternal level to rise (as it does after a single birth) and that this in turn raises

TABLE I

Showing the Results of Duplicate Plasma α-Amino-Nitrogen Estimations on 8 Maternal and Twin Foetal Bloods Obtained at Vaginal Delivery

Case No.	Sex	Twin Type	Maturity in Days from Expected Date of Delivery	Birth Weights		Placental Weights		Plasma α-NH_2-N. mg./100 ml.			α-NH_2-N. Foetal/ Maternal Ratios		Time Between Deliveries in Minutes
				Twin 1 g.	Twin 2 g.	Twin 1 g.	Twin 2 g.	Mother	Twin 1	Twin 2	T1/M	T2/M	
32	M. F.	DZ. DC.	−12	3,150	2,320	500	370	2·73 2·69	4·19 4·16	4·31 4·46			
								2·71	4·17	4·38	1·54	1·62	15
24	F. F.	DZ. DC.	−25	2,030	2,480	770		3·52 3·52	4·44 4·48	4·99 4·98			
								3·52	4·46	4·99	1·27	1·42	30
26	M. F.	DZ. DC.	−43	1,910	1,820	390	370	4·26 4·06	5·10 5·18	5·25 5·31			
								4·16	5·14	5·28	1·23	1·27	13
19	M. M. (Visible vascular communications)	MZ. MC.	−22	2,950	3,860	1,165		2·62 2·79	2·81 3·01	4·29 4·29			
								2·71	2·91	4·29	1·08	1·59	30
16	F. F.	DZ. DC.	−1	2,130	1,810	340	350	2·43 2·30	5·00 5·19	4·26 4·16			
								2·36	5·09	4·21	2·16	1·78	
25	F. F. (Visible vascular communications)	MZ. MC.	?	2,820	3,270	1,150		4·46 4·49	5·79 5·78	5·99 5·84			
								4·47	5·79	5·92	1·29	1·32	10
21	F. M.	DZ. DC.	−32	2,090	2,110	340	325	3·38 3·39	4·99 5·12	5·19 4·99			
								3·39	5·05	5·09	1·49	1·50	25
15	M. M.	DZ. DC.	−8	2,770	1,815	450	270	2·91 2·83	4·38 4·35	6·37 6·44			
								2·87	4·36	6·41	1·62	2·23	85

These results are not corrected for urea.
DZ. DC. = Dizygotic-Dichorial.
MZ. MC. = Monozygotic-Monochorial.

the level in the second twin. If this is so, the comparison of the plasma amino-acid levels of single and twin bearing mothers should have been carried out by a study of blood samples taken before labour.

Moreover, this study of the relative placental functions of twins would have been more valuable if a maternal blood sample had been taken immediately after the birth of each twin. Even more useful would be a study of twins

TABLE II

Showing the Results of Plasma α-Amino-Nitrogen Estimations (not duplicated) on Blood Samples from a Further 8 Sets of Twins and Their Mothers Obtained at Vaginal Delivery

Case No.	Sex	Twin Type	Maturity in Days from E.D.D.	Birth Weights		Placental Weights		Plasma α-NH_2-N. mg./100 ml.			α-NH_2-N. Foetal/ Maternal Ratios		Time Between Deliveries in Minutes
				Twin 1 g.	Twin 2 g.	Twin 1 g.	Twin 2 g.	Mother	Twin 1	Twin 2	T1/M	T2/M	
20	M. M.	DZ. DC.	−48	2,300	1,670	400	200	4·06	4·44	5·29	1·09	1·30	20
31	M. F.	DZ. DC.	−39	2,650	1,570	720	320	3·29	4·46	4·88	1·36	1·48	28
23	F. F.	MZ. MC.	−27	1,280	1,670	603		3·48	5·89	4·80	1·69	1·38	25
27	M. M.	DZ. DC.	+7	2,330	1,840	733		3·50	5·72	5·90	1·63	1·68	19
17	F. M.	DZ. DC.	−3	2,550	2,665	—	—	2·85	4·37	3·58	1·54	1·26	8
29	M. M.	DZ. DC.	−5	3,910	3,600	900		3·44	4·70	5·15	1·37	1·50	17
34	F. M.	DZ. DC.	−15	2,960	2,790	530	390	4·46	6·34	6·45	1·42	1·45	85
22	F. M.	DZ. DC.	−26	1,700	2,410	270	380	2·27	4·55	5·60	2·00	2·47	20

These results are not corrected for urea.
DZ. DC. = Dizygotic-Dichorial.
MZ. MC. = Monozygotic-Monochorial.

delivered by elective Caesarean section where the time between the two deliveries is reduced to a minimum.

SUMMARY

Free plasma alpha-amino-nitrogen estimations have been carried out on blood samples collected from 16 sets of twins and their mothers at vaginal delivery.

Duplicate estimations on 8 sets show that real differences do exist in the plasma amino-acid levels of twins at birth. No relationship was found between birth weight and either the foetal or the maternal amino-acid levels.

There is a tendency for the second born twin to have a higher level than the first born.

It is suggested that further studies should be made at Caesarean sections where the time between the two deliveries is reduced to a minimum.

ACKNOWLEDGMENTS

I am indebted to Miss J. Churchman for technical assistance in this work.

The majority of the subjects in this study were patients at University College Hospital. Access was also given to other London hospitals, and I wish to thank the obstetricians concerned, namely, Miss Josephine Barnes at the Annie McCall Maternity Hospital, Mr. A. D. Crey at the Charing Cross Hospital, Professor McClure Browne at the Hammersmith Hospital, Mr. F. Roques at the Middlesex Hospital and Mr. Kirwan Taylor at St. George's Hospital.

I wish to thank Dr. S. D. Lawler for determining the blood groups and sub-groups of the like sexed twins, and Mr. N. W. Please for statistical advice.

I wish also to express my gratitude to the Board of Governors of University College Hospital for making this investigation possible.

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SPHINCTEROMETROGRAPHY

A New Technique for Studying the Physiology and Pathology of Urinary Continence in the Female

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IN recent years several radiographic studies of the female bladder and urethra have been reported, usually in an attempt to elucidate the aetiology and pathogenesis of urinary stress incontinence in women. Of these, the overwhelming majority are descriptions of anatomical features supposed to be significant with regard to the mechanism of continence and the production of incontinence.

Norris and Kimbrough (1928), Millin and Read (1948) and Muellner (1949) maintained that funneling and marked descent of the base of the bladder on straining are the most characteristic radiographic findings in cases of stress incontinence, while Jeffcoate and Roberts (1952a, b) believed that funneling is not the important feature in these cases and that downward movement of the bladder base appears to be related to the degree of prolapse present rather than to the severity of the incontinence. Sagging of the bladder base and urethra, often with descent to extreme limits on straining may be present in the absence of any incontinence. Blaikley (1952) and Palmrich (1954) expressed the same opinion.

Thomsen (1930, 1932) believed that anterior angulation of the uppermost part of the urethra is essential for continence and that loss of this anterior angle leads to stress incontinence, while De Azevedo and Campos (1932) maintained that the important prerequisite for continence is the presence of anterior and posterior vesico-urethral angles of equal size. Jeffcoate and Roberts (1952a), on the other hand, found that the posterior vesico-urethral angle was the important one for continence and that this angle was lost in 4 out of every 5 cases of stress incontinence, although they admitted that several women were cured by vaginal repair operations without correction of the posterior vesico-urethral angle. Ingelman-Sundberg (1955) has found that the posterior vesico-urethral angle was absent in many women who were perfectly continent so that the urethra and trigone formed a straight line. Edling (1950) described angulation of the urethra as a sure sign of incontinence.

Ball (1950) found that the characteristic radiographic sign in cases of stress incontinence is that the region of the internal orifice, on straining, moves a little downwards and clearly forwards and comes to lie in front of the lateral bore of the symphysis. Power (1954), on the contrary, believed that the internal vesical os moves downwards and backwards while Hodgkinson (1953) maintained that in cases of stress incontinence straining causes vertical descent of the bladder and urethra without rotation.

It can readily be seen that workers on cystography and urethrography have so far devoted too much attention to details of structure and too little to the study of function. Their widely differing and often diametrically opposing views have not helped to clarify the situation and have, if anything, added to the confusion and multi-

plicity of the surgical procedures advised for the relief of this condition. Indeed Aldridge (1952) has stressed the difficulty of evaluating the importance of anatomical changes which are usually observed in women who have stress incontinence and of devising well defined surgical procedures by which control of urination is likely to be restored.

The only attempt to evaluate the function of the sphincters by a radiographic method was made by Kennedy (1937) and his experiment was repeated by Hartl (1953) and by Barnes (1940) who rightly believed that "to the patient, function rather than shape is important; a single band able to resist pressure is more valuable than a normally shaped urethra with no inherent power of effective resistance". The method consisted of introducing a small balloon composed of two superimposed rubber cots into the urethra. The balloon was filled from without by a radio-opaque solution and connected to a manometer and X-ray pictures were taken under different manometric pressures. The degree of dilatation of the balloon indicated the strength or weakness of the different urethral segments and their supposed sphincters. Although intended for the study of function, the method was quite unphysiological, for filling of the urethra and stretching of its sphincters was exerted from below upwards, i.e., the conditions of the experiment were exactly opposite to those obtaining in normal micturition. The method has, therefore, been severely criticized and never enjoyed wide application. Power (1954), for example, doubted whether the resistance encountered by filling the urethra with a radio-opaque substance in the way suggested by Kennedy could be interpreted as true sphincteric action. The method, in addition, takes no account of the intravesical pressure although Barnes himself (1940) maintained that continence depends on a normal functional balance between this pressure and the urethral sphincter mechanism and that incontinence could result from either an increase in the intravesical pressure or a lowering of the urethral sphincter action or a combination of both.

After several attempts, we have devised a method based on physiologic principles to assess the strength of the sphincters of the bladder and urethra and their power to resist different recordable intravesical pressures. Because it aims at measuring the strength of the sphincters by radiographic means, we have coined for it the name "sphincterometrography".

Material and Method

More than 100 sphincterometrographic assessments have been made, including:

(1) Normal nulliparous and multiparous women, (2) cases of varying degrees of prolapse without stress incontinence, (3) cases of varying degrees of stress incontinence without prolapse, (4) cases of prolapse with stress incontinence, and (5) women in the first week after delivery, normal and abnormal.

The pathological cases were subjected to thorough investigation including cystoscopy, cystometry and air sphincterometry. These latter methods also yielded useful information and their results will be reported elsewhere.

Sphincterometrography. We use a Miller-Abbott tube (a double channelled rubber tube 0·6 cm. in diameter with perforated metal tip, Fig. 1). The balloon of the tube is replaced by one made from a medium sized Super-Tex condom sheath. The very thin and elastic rubber of the latter was found to suit admirably the purpose of the experiment. After many trials we found it best to use a balloon of 6 cm. length and 40 ml. capacity. The patient is placed in the supine position on the X-ray table. The balloon and metal tip are lubricated with sterile paraffin and, after spraying a local anaesthetic (Mucathane) on to the external meatus, the tube is introduced into the urethra until the balloon lies well inside the bladder. The smaller channel of the tube communicates with the balloon and through it the latter is filled with 40 ml. of 25 per cent sodium iodide solution. The tube is then pulled down until the balloon comes to lie directly on the base of the bladder in the region of the internal meatus. The larger channel of the tube communicates with the opening at the metal tip and through it the bladder is filled with 150 ml. of 5 per cent sodium iodide solution. This channel is then connected to a special manometer, which records directly the pressure inside the bladder. We have used the manometer illustrated in

Fig. 2 constructed by the Genito-Urinary Mfg. Co. Ltd., London, which records the pressure in centimetres of water but any simple water manometer will serve the purpose. The usual intravesical pressure at rest, under the conditions described, was found to be about 10 cm. of water. (This is the average pressure recorded by cystometry when the normal bladder contains 150–200 ml. of fluid.) An antero-posterior radiograph is made at this initial pressure. The patient is then requested to strain or bear down and another radiograph is made when the intravesical pressure reaches 30 cm. of water. The patient is then asked to strain as much as she can and a third radiograph is made at the maximal intravesical pressure recorded which usually ranges from 60 to 80 cm. of water. The following points are then carefully studied and compared in the 3 films:

(1) The level of the bladder base.

(2) The presence of funneling of the bladder base.

(3) Descent of the balloon below the level of the bladder base. Because of the difference in density between the shadow of the balloon (filled with 25 per cent sodium iodide solution) and that of the bladder (filled with 5 per cent sodium iodide solution), it can be easily determined whether the balloon remains within the bladder base or whether it descends below it, i.e., passes into the urethra.

Results

The findings in the different groups of cases investigated will now be described separately:

A. Normal Nulliparous and Multiparous Women

(1) The bladder base initially lies somewhere between the upper border and the middle of the pubic symphysis. No appreciable descent occurs as the intravesical pressure rises (Fig. 3).

(2) Funneling was noticed in about one-tenth of the normal cases but only in the third radiograph (under maximal intravesical pressure). (Fig. 4.)

(3) The balloon was never seen, under any circumstances, to descend below the bladder base.

B. Cases of Prolapse Without Stress Incontinence

(1) The bladder base may lie initially at the normal level or may be lower. As the intravesical pressure rises it always descends markedly and the descent is proportionate to the increase in pressure, so that it was more marked in the third than in the second radiograph.

(2) In most cases the descent of the bladder base is accompanied by marked funneling (Fig. 5). In about one-fifth of the cases no appreciable funneling was noted even under maximal intravesical pressure when the bladder base went down to a very low level (Fig. 6).

(3) The balloon never descended below the bladder base, i.e., it always remained inside the bladder even in the presence of marked descent and funneling (Figs. 5 and 6).

C. Cases of Stress Incontinence Without Prolapse

(1) The bladder base lies initially at the normal level. No appreciable descent occurs as the intravesical pressure rises.

(2) Funneling may be noticeable at the initial pressure (first radiograph). It usually becomes more marked as the intravesical pressure rises. Sometimes no appreciable funneling is present.

(3) The balloon always descends below the bladder base. This descent was rarely noticeable in the first film except in cases of complete incontinence. It sometimes became marked when the intravesical pressure reached 30 cm. of water and sometimes was only apparent in the third radiograph (under maximal intravesical pressure). (Fig. 7.) The more severe the case clinically, the lower was, as a rule, the intravesical pressure sufficient to drive the balloon outside the bladder. In not one single case of stress incontinence did the balloon remain within the bladder base when the intravesical pressure rose to its maximal limit. In the great majority of cases the descent of the balloon was limited even under maximal intravesical pressure to the upper one-third or one-half of the urethra which became markedly dilated. The extent to which the urethra can dilate in some of these cases is indeed remarkable (Fig. 8). The abnormal dilatation of the urethra in cases of stress incontinence has been described by several previous workers including Ingelman-Sundberg (1952) and Aldridge (1952). In only 3 cases did

the balloon descend down the whole length of the urethra. In 2 of them the balloon was expelled from the external meatus (Fig. 9), and in one this was prevented by the balloon being again held by constriction at the middle third of the urethra (Fig. 10). All 3 women were, clinically, completely incontinent, i.e., they did not only lose urine on stress but were incontinent even when lying down in bed.

D. Cases of Prolapse With Stress Incontinence

The findings were a combination of those described under (*B*) and (*C*).

(1) The base of the bladder lay initially at normal or lower level. Descent always occurred with rise of the intravesical pressure.

(2) Funneling was in most cases present.

(3) Descent of the balloon below the bladder base invariably occurred at maximal intravesical pressure (Fig. 11) and was sometimes already noticeable at lower pressures, again corresponding to the clinical severity of the incontinence.

Interpretation of the Results

Correlation of the clinical observations with the radiographic findings has led to the following important conclusions:

(1) Descent of the bladder base as the intravesical pressure rises on straining is a feature of prolapse and not of stress incontinence. It was noticeable in all cases of prolapse and not in cases of stress incontinence except when associated with prolapse.

The bladder is normally supported by the pelvic floor and by the pubovesical cervical fascia (Bonney, 1923). Descent of the bladder base on straining is due to weakness of these structures associated with prolapse.

(2) In continent women, even if marked prolapse was present, descent of the balloon below the base of the bladder was never observed even at maximal intravesical pressure. This indicates that a high intravesical pressure cannot cause stress incontinence if the sphincter mechanism is intact. In cases of stress incontinence the balloon always descended below the bladder base and the intravesical pressure at which this occurred varied with the severity of the clinical condition. The weaker the sphincter mechanism, the less is the intravesical pressure which it will be able to resist. It is obvious that conditions which tend to raise the intravesical pressure, e.g., local bladder lesions, faulty innervation, advanced pregnancy and abdominal and pelvic tumours may, in the presence of a weak sphincter mechanism, precipitate the appearance of stress incontinence or may aggravate the condition if already present.

In women who were clinically incontinent on stress, the balloon descended in the upper one-third or one-half of the urethra. Further descent was obviously prevented by contraction of the external voluntary sphincter (compressor urethrae). Stress incontinence is therefore not due to weakness of the compressor urethrae or of the pelvic floor but to weakness of the internal (vesical) sphincter. This is a smooth muscle sphincter which is believed to consist of two loops. The first and stronger loop embraces the neck of the bladder as a horseshoe from the front and the second surrounds the bladder neck from behind (V. Ludinghansen, 1932; Martius, 1954). Our finding that the internal vesical sphincter is the most important factor in the maintenance of continence supports the contentions of previous authors (Martius, 1954; Jeffcoate and Roberts, 1952b; Mulvany, 1952; Power, 1954). The latter author concluded from his anatomical investigation that "only the intramural, i.e., the intravesical part of the urethra with its smooth muscle arrangement as the direct continuation of the trigone represents the lock for the maintenance of continence under physiological conditions". The external voluntary sphincter (compressor urethrae) is brought into play when, under stress, the internal sphincter fails to resist the raised intravesical pressure. Owing to its action the balloon did not descend into the lower half of the urethra in most cases of stress incontinence. The role of the compressor urethrae in the maintenance of continence is, therefore, only secondary. Indeed, we have on occasion, as has Stanley Way (1951), excised more than one-half of the urethra in the radical operation for carcinoma of the vulva without any impairment to urinary continence.

In 3 cases of complete incontinence the balloon went down the whole length of the

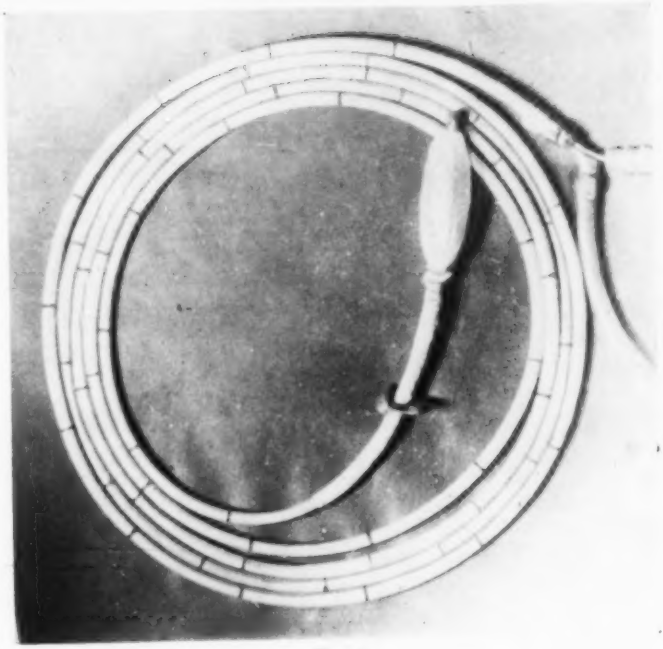

FIG. 1
Miller-Abbott tube.

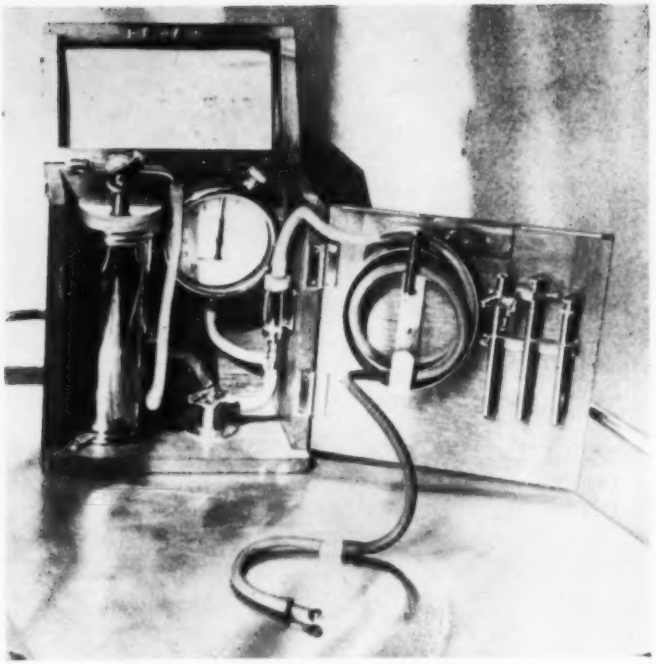

FIG. 2
Apparatus for recording the intravesical pressure in centimetres of water.

FIG. 3
Normal multiparous woman. On straining, bladder base remains at normal level.

FIG. 4
Normal multiparous woman with funneling under maximal intravesical pressure. Bladder base at normal level.

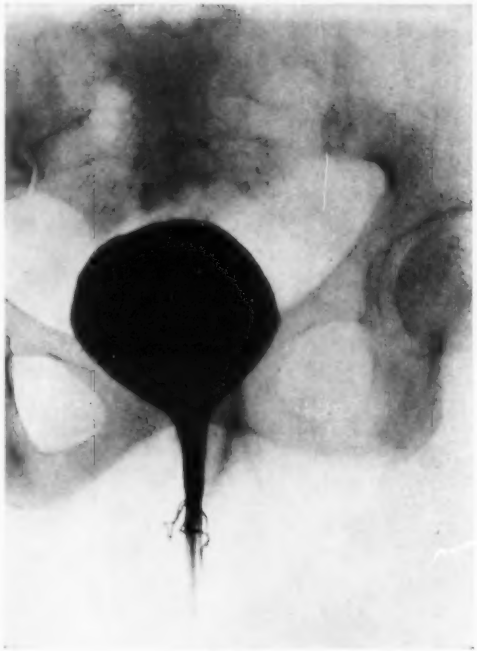

FIG. 5
Case of prolapse. Bladder base descends on straining. Funneling is also apparent.

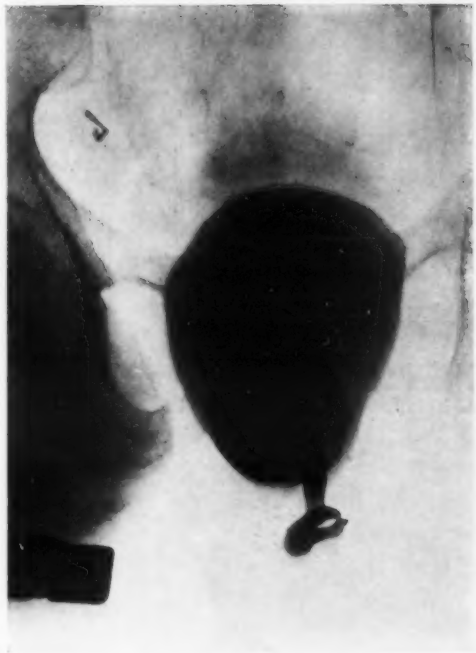

FIG. 6
Case of prolapse. Bladder base descends on straining but funneling is absent.

FIG. 7
Case of stress incontinence without prolapse. Bladder base at normal level with the patient straining maximally. Balloon descending below the bladder base.

FIG. 8
Case of stress incontinence without prolapse. Bladder base remains at normal level on straining. Balloon descends below the bladder base. Note marked dilatation of the upper urethra.

FIG. 9
Case of stress incontinence without prolapse. In this case the balloon was completely expelled from the urethra at maximal intravesical pressure. Note that the bladder base is at normal level.

FIG. 10
Balloon descended down the whole length of the urethra but was not expelled due to contraction subsequently taking place at the middle third of the urethra.

FIG. 11
Case of prolapse with stress incontinence. Marked descent of base of bladder on straining. Balloon descended below the bladder base.

FIG. 12
Case of urgency incontinence with intact sphincter mechanism. Balloon remained within the bladder base at maximal intravesical pressure.

FIG. 13a
Case of stress incontinence before operation. Funneling and descent of the balloon below the bladder base on stress at intravesical pressure of 30 cm. of water.

FIG. 13b
Same case after operation. No descent or funneling present at maximal intravesical pressure (70 cm. of water).

urethra. This means that in some advanced cases of incontinence the tone of the compressor urethrae is also lost. Once the resistance of the compressor urethrae was overcome, the balloon was extruded. There was therefore no evidence that a sphincteric mechanism exists in the part of the urethra distal to the urogenital diaphragm.

(3) Descent of the bladder base on straining is thus pathognomonic of prolapse, and escape of the balloon into the urethra is pathognomonic of incontinence. Funneling of the bladder base is not a constant or a characteristic feature of either prolapse or incontinence. If funneling occurred in continent women on straining, the thin elastic balloon was seen to accommodate itself to the funnel-like shape of the bladder base but always to remain within the latter; the apex of the balloon then lay at the intact internal meatus (Figs. 4 and 5). Funneling of the bladder base is not due to weakness of the bladder supports (pelvic floor, pubo-vesical cervical fascia), for, if it were, it would have been present in all cases of prolapse when these structures are weak and it would not have been observed in cases without any sign of descent. The older concept that the levator ani muscles send fibres to the urethra and bladder base (Davies, 1938; Curtis *et al.*, 1942), has not been confirmed by more recent work on the subject (Roberts, 1953; Krantz, 1950; Mulvany, 1952). Nor can the funneling be due to weakness of the internal (vesical) sphincter for it is seen in many women who are continent and is sometimes absent in cases of incontinence.

In our opinion, the funneling is due to weakness of the intrinsic voluntary muscle fibres of the urethra. These fibres are arranged around the upper part of the urethra obliquely and are inserted into the bladder base (Henle, 1856; Zangemeister, 1909; Jeffcoate and Roberts, 1952b). The voluntary muscle fibres of the urethra increase gradually in thickness and strength as they are traced from the bladder downwards (Hartl, 1953; Power, 1954). This fact, plus their diagonal arrangement, explains why the bladder base appears funnelled when they are weak or relaxed.

It is not surprising that weakness or relaxation of these intrinsic voluntary muscle fibres of the urethra should be commonly associated with the weakness or the relaxation of the pelvic floor that explains the frequent appearance of funneling in cases of prolapse. Weakness or relaxation of these fibres will conceivably increase the inefficiency of a weak internal (vesical) sphincter which becomes less well supported but, like the compressor urethrae, they only play a secondary role in the aetiology of stress incontinence since funneling may be marked in perfectly continent women and stress incontinence may occasionally be present in the absence of funneling.

Discussion

Sphincterometrography represents a simple objective method for assessment of the efficiency of the sphincter mechanisms of the bladder and urethra and their resistance to changes in the intravesical pressure.

The method has been found to possess several advantages:

(1) It has yielded useful information concerning the physiology of urinary continence in the female and the relative importance of the different components of the sphincter mechanism.

(*a*) No increase in the intravesical pressure can lead to incontinence if the sphincter mechanism is intact.

(*b*) The internal (vesical) sphincter is by far the most important factor in the maintenance of continence.

(*c*) The intrinsic voluntary muscle of the urethra and the external sphincter of the urethra (compressor urethrae) play only a subsidiary role in the maintenance of continence.

(*d*) No sphincter mechanism exists in the part of the urethra distal to the urogenital diaphragm.

(*e*) The level of the bladder base and the presence or absence of funneling have no direct relation to the maintenance of continence.

(2) It is useful in the diagnosis of the type and severity of incontinence. In conditions like urgency incontinence and neurogenic bladder, with an intact sphincter mechanism, the balloon always remains within the bladder base, however high the intravesical pressure may be (Fig. 12). The clinical differentiation between the

different types of incontinence may sometimes prove difficult, and mixed types occasionally occur. Many therapeutic failures are due to inaccurate diagnosis.

The assessment of the severity of stress incontinence has so far been mainly based on subjective evidence and such ill-defined terms have been used as mild and severe or partial and complete. Sphincterometrography allows an accurate objective evaluation to be made by noting the intravesical pressure at which the internal sphincter yields and the degree of descent of the balloon down the urethra.

(3) The method is helpful in planning the operative treatment for the individual case. In cases where the resistance of the internal sphincter is only overcome when the intravesical pressure reaches its maximal limit, a simple Kelly plication will usually be sufficient. If the balloon is seen to pass into the urethra even at the initial (resting) pressure, which is a rare occurrence except in some severe cases, the internal vesical sphincter is probably so attenuated that a simple vaginal repair is not likely to give lasting results and it is preferably to be combined with some type of sling operation. The sling, passing behind the vesico-urethral junction, will contract when the patient strains and will thus augment the action of the weak internal (vesical) sphincter at the critical moment when the intravesical pressure rises. There is therefore a place for a primary sling operation in a small number of these cases as has been emphasized by Aldridge (1952), TeLinde (1953) and Wilfred Shaw (1954).

If funneling is a marked feature indicating weakness of the intrinsic voluntary muscle fibres at the upper urethra and the bladder base, we bring together the mobilized anterior portions of the divided pubo-coccygeus muscles to form a strong layer underneath the neck of the bladder as described by Ingelman-Sundberg (1946, 1947). If descent of the bladder base is a marked feature (stress incontinence with prolapse), the plastic operation for the repair of the prolapse is combined with a Kelly plication and the lateral portions of the pubo-vesico cervical fascia are sutured together in the midline to form a layer supporting the bladder and its neck as practised by TeLinde (1953). In such cases, especially if funneling is also present, the Ingelman-Sundberg anterior pubo-coccygeus repair may be done as an additional step.

If the external voluntary sphincter is also weak, as evidenced by the balloon going down the whole length of the urethra, repair of the compressor urethrae (deep transversus perinei muscles) must also be undertaken, on the lines described by Johnston (1931) and Davies (1938).

Repair of the bulbocavernosus muscles is of doubtful value for there is no evidence that these muscles exert a sphincteric action on the urethra under normal conditions.

We have no experience of the Marshall-Marchetti-Krantz operation (1949) of cystopexy. The beneficial action of such a procedure would seem to be due to the fact that upward fixation of the bladder neck mechanically increases the efficiency of the internal (vesical) sphincter. The firmer the *point d'appui* for the sphincter, the more efficient is its action (Johnston, 1931).

(4) Sphincterometrography is valuable for assessment of the results of treatment in cases of stress incontinence. In describing these results such terms are usually used as "good, moderate or poor" and "complete, partial or no relief". The method provides an objective means of comparing, among other things, the efficiency of the sphincter mechanism before and after treatment (Fig. 13).

(5) Sphincterometrographic assessment of cases of stress incontinence before and after operation may prove helpful in comparing the value of different operative procedures performed by different authorities on cases which may differ in nature and severity. Such comparison has hitherto been difficult and this is, in our opinion, an important reason for the present wide divergence of opinion on the treatment of these cases. The method is simple and can be used for examination of all cases of incontinence under standard conditions.

(6) Sphincterometrographic examination of women in the first week after labour has revealed certain points of interest and the results will be reported in detail in a future communication. Some cases have shown features which are ordinarily present only in association with manifest stress incontinence, prolapse or both. The radiographic findings were usually out of

proportion to the clinical manifestations and they did not seem to be related to the type of delivery.

Careful follow-up is necessary to determine whether cases that show such abnormal radiographic appearances in the immediate postpartum period will in future develop manifest prolapse or stress incontinence. We are also investigating the question whether physiotherapy, pelvic floor exercises, etc., as recommended by Kegel (1948, 1951) can modify the sphincterometrographic findings in the seemingly abnormal post-partum cases. Work on these lines may have far-reaching results from the point of view of prophylaxis of prolapse and stress incontinence of urine.

Summary

A simple radiographic technique has been devised to evaluate the efficiency of the sphincter mechanisms of the bladder and urethra and to measure their power to resist changes in the intravesical pressure. The method has shed some light on certain disputed problems in the physiology and pathology of urinary continence in the female. It has also been useful in the diagnosis of the nature and the severity of incontinence, in the choice of operative treatment and in assessing its results. It may prove of value in comparing the results of different therapeutic procedures designed to cure stress incontinence. Its application to the examination of women shortly after labour has revealed certain points of interest which may prove important in the prophylaxis of stress incontinence and prolapse.

The first author wishes to express his gratitude to Professor T. N. A. Jeffcoate, Mr. C. M. Marshall and Dr. H. Roberts of Liverpool, to Professor A. Ingelman-Sundberg of Stockholm and to Professor H. Martius and Dozent H. Hartl of Gottingen whose pioneer works have aroused his interest in problems of female urology during his presence in their clinics and have given the inspiration to carry out this research. We are indebted to Professor Ali H. Shaaban of the Department of Gynaecology and to Professor Mostafa Ragheb of the Institute of Radiology, Kasr El Aini Hospital, Cairo, for encouragement and advice.

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THE CLOSURE OF THE FEMALE URETHRA

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THE female urethra is described as a tube about 4 cm. long imbedded in the anterior wall of the vagina. The anterior and posterior walls are in apposition except during the voiding of urine. The urethral lumen is obliterated by the contraction of the muscles within or closely connected with its walls. An internal involuntary and an external voluntary sphincter urethrae are described (Johnstone, 1954). However in stress incontinence of urine the physiological defect is not well understood.

De Azevedo and Cabelo Campos (1932) stated that the continuity of the urethra with the bladder in a rounded line instead of the normal angle-shaped separation was almost always accompanied by incontinence of urine. Other workers have since supported this view though Stevens and Smith (1937) disagreed. An excessive descent of the bladder neck was considered a feature of stress incontinence by Millin and Read (1948), while a distinctive shape and angulation of the urethra was thought by Thomsen (1932) to be a diagnostic feature.

The behaviour of the sphincters of the bladder and urethra described by Muellner (1951) and Roberts (1953) are at variance with the observations of Denny-Brown and Robertson (1935) and of Hinman, Miller, Nickel and Miller (1954). These contradictory observations have stimulated our interest in the normal mechanism of closure of the female urethra.

While investigating patients with stress incontinence of urine, barium urethrocystography had been performed in 120 subjects. Conventional radiographs were taken in the lateral projection, with the subject at rest, straining and during voiding. Approximately half of the patients also had films taken in the antero-posterior projection. However, the information obtained by this method provided no means of observing the opening and closing of the urethra and therefore we had recourse to rapid serial radiography as described below.

MATERIALS AND METHOD

Twenty-seven women were examined; their clinical states are summarized in Table I. In view of the possible genetic effects of a radiological examination we considered it unjustified to examine young persons where there was no clinical indication. One subject had come into hospital for termination of pregnancy and sterilization.

TABLE I

27 Patients Investigated by Rapid Serial Radiography

Subjects with no Disorders of Micturition (ages 25–47 years)	
Nulliparous	2
No vaginal deliveries, 3 Caesarean sections	1
Primiparous, 12 weeks pregnant	1
Multiparous	7
Total	11
Subjects with Stress Incontinence of Urine (ages 34–69 years)	
Uncomplicated	10
After pelvic floor repair	5
After 2 pelvic floor repairs and a sling operation	1
Total	16

A clinical history was taken and a gynaecological examination made in all the patients for urethrocystography. The patient was catheterized and the bladder was emptied, and the volume of residual urine measured. Enough barium sulphate suspension (Micropaque, Damancy and Co.), diluted with an equal volume of water, was injected through the catheter to produce a sensation of fullness, usually 250 to 300 ml. No complications developed from the use of barium sulphate. Cystoscopy performed within 24 hours in 2 patients showed the bladder mucosa to be completely cleared of barium.

The rectum and anal canal were outlined by the injection of a little of the suspension, and the vaginal walls were smeared with a barium sulphate cream. The subject sat on a wooden commode of a similar design to that described by Roberts (1952). Rapid serial radiography in the lateral projection was found to be the most satisfactory for showing the relationship of the bladder, urethra, vagina and rectum. Only a small number of antero-posterior studies have been made. Some, but not all of the following conditions, have been examined in every subject.

(1) Sitting without any deliberate muscular effort.
(2) Straining or bearing down.
(3) Coughing.
(4) Voiding.
(5) While interrupting the stream involuntarily, i.e., hesitant voiding in a nervous or embarrassed subject.
(6) Voluntary interruption of an established stream.

The X-ray generator was a constant potential unit (Messrs. General Radiological Ltd.). The films were exposed at the rate of 2, 3 or 4 per second in a 35 mm. cine camera, used in conjunction with a Philips X-ray image intensifier, as described by Ardran and Wyatt (1954). The image intensifier covered a circular field of approximately 5 inches in diameter.

Radiographic data: Focus-amplifier distance 36 inches.
Filter—3 mm. aluminium.
Grid—6:1 Lysholm.
100 kV, 100 mA, 6·5 mAs per exposure.

Using these factors the skin dose for a subject 13 inches thick was 5 r for 20 exposures. Since this measurement was made in free air, 20 per cent may be added for back scatter. Usually only 40 frames were exposed, the maximum being 100. The maximum skin dose given was 30 r. This dose compares favourably with those employed in conventional radiography (Ardran and Crooks, 1953).

Results

The Bladder at Rest

The films made with the image intensifier cover only the base of the filled bladder and urethra. The following account is derived partly from the conventional radiographs which formed the preliminary study.

With the subject sitting at ease the contours of the filled bladder, as seen in the lateral radiograph, are variable, but may be considered to form a triangle (Figs. 1 and 2).

A curved superior border unites anteriorly, at the rounded apex, with the anterior border, and fuses posteriorly with the postero-inferior border. The anterior border is frequently relatively straight (except for an indentation related to the symphysis pubis) and unites with the postero-inferior border at the neck of the bladder. The base of the bladder may be described as that portion of the postero-inferior border which extends backwards from the neck and is in relation to the anterior wall of the vagina. In the middle third of the contour of the base of the bladder there is frequently an indentation which we believe to indicate the posterior limit of the trigone (Figs. 1 and 2).

Women Without any Disorder of Micturition

The base of the bladder was visualized at rest and during straining in all 11 subjects; during voiding the urethra was also seen. With the subjects sitting at ease, in 9 of the patients the internal meatus was indicated by a small projecting "beak" of contrast medium, varying from 2 to 5 mm. in length at the junction of the base and the anterior border of the bladder. There was no indication of the internal meatus in the other 2 subjects. In one parous patient a portion of the anterior bladder wall, in front of the internal meatus, was in a straight line with the bladder base.

On straining or coughing the vagina and the bladder base together with the internal meatus moved downwards and forwards in 9 patients; in 2 patients there was only downward movement. This descent was greater on straining than on voiding and considerable descent of the bladder neck on straining was present in 5 out of 11 subjects. The movement of the bladder base in some of the parous patients was so great as to form a cystocele; in these circumstances a portion of the base was in line with the anterior wall and the urethral origin thus appeared to be on the anterior wall. Also, on straining, the small "beak" of contrast medium in the internal meatus became more pronounced, and the angle between the anterior border and the bladder base more acute. On relaxation the pelvic structures returned to their position of rest and the "beak" of barium in the urethra became smaller, although sometimes remaining more pronounced than previously.

Many of the subjects found it difficult to void to order. A variable amount of preliminary straining occurred and some started hesitantly, stopping several times before a free flow was established. In all the "beak" appeared as on straining and then the contrast medium passed on to show the full length of the urethra.

During voiding the urethra dilated to a variable degree. The junction between the proximal two-thirds and the distal one-third was usually narrowed and the distal urethra bent downwards (Fig. 3). Frequently a slight narrowing or indentation was visible in the proximal third, roughly at the level to which the "beak" of contrast medium could be seen on straining. The contours of the urethra varied considerably during voiding, appearing at times to have an almost uniform diameter with parallel walls. When voiding began the bladder, as seen in the lateral radiograph, appeared ovoid; the bladder neck descended a little in the majority of the patients. As emptying continued the contour of the bladder became almost circular in outline, with a gradually diminishing diameter. In some subjects an indentation appeared in the base at a variable distance behind the neck of the bladder. The outline of the bladder appears crenated except in the region of the base between the indentation (which we believe corresponds to the trigone) and the bladder neck. Towards the end of the act of voiding the trigone region gradually rose from the vagina, the posterior portion higher than the anterior, so that this part of the bladder base, which at rest was almost horizontal became almost vertical (Figs. 4 and 5).

The urethra and the anterior border of the bladder meet at an acute rounded angle. When voiding began a posterior urethrovesical angle less than 180° was present in all but one parous patient, although later, as the bladder emptied, the angle became 180° in some of the subjects. As the bladder became almost completely empty the urethra became progressively narrower. We were unable to visualize clearly the path taken by the last few drops of contrast medium. There was a considerable but a variable distance between the anterior vaginal wall as outlined by barium and the contour of the filled urethra. During voiding, the bladder base and the urethra, except at its distal end, moved independently of the vagina.

Interruption of the Stream

When the stream of contrast medium was interrupted, the urethra was obliterated at the junction of the proximal two-thirds and the distal third (Fig. 6). Obliteration took place from this point progressively backwards to the internal meatus, the contraction involving the whole of the urethra, the contents being expressed backwards into the bladder. The urethra emptied to the region of the internal meatus, leaving only a small beak of contrast medium. The contents of the distal urethra appeared to be expressed downwards and outwards. In none of our subjects was the interruption of the stream made at the proximal sphincter. In some individuals the whole of the urethra narrowed considerably before the interruption occurred (Fig. 7).

The subjects who had difficulty in initiating a free flow sometimes passed a small amount of fluid and then stopped; sometimes the contrast medium only reached the middle third of the urethra before it was returned to the bladder. There was no detectable movement of the bladder base and the urethral closure appeared to be due to the muscle in or closely related to it.

When the subject was asked to stop voiding,

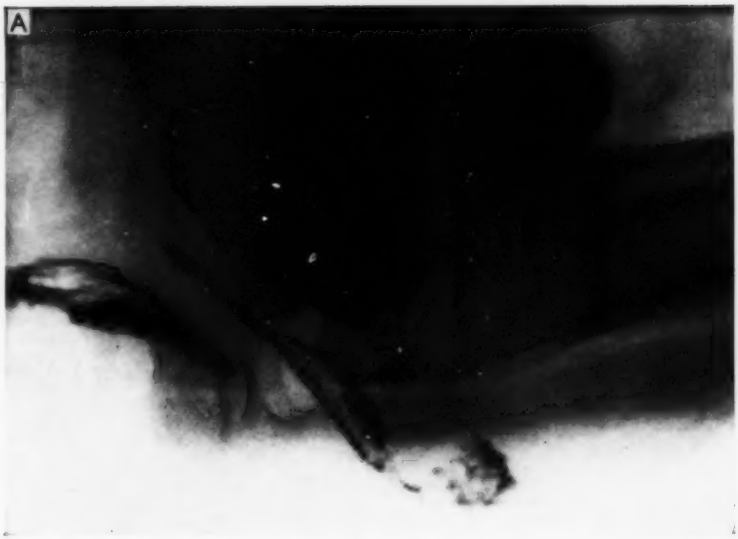

FIG. 1

Lateral barium cystogram with the patient at rest.

(*a*) A nulliparous patient, aged 40, with no urinary symptoms; the normal "triangular bladder". The barium outlines of the rectum and vagina are shown in relation to the bladder base. A "beak" of barium projects into the internal meatus, at the junction of the straight anterior border and the bladder base.

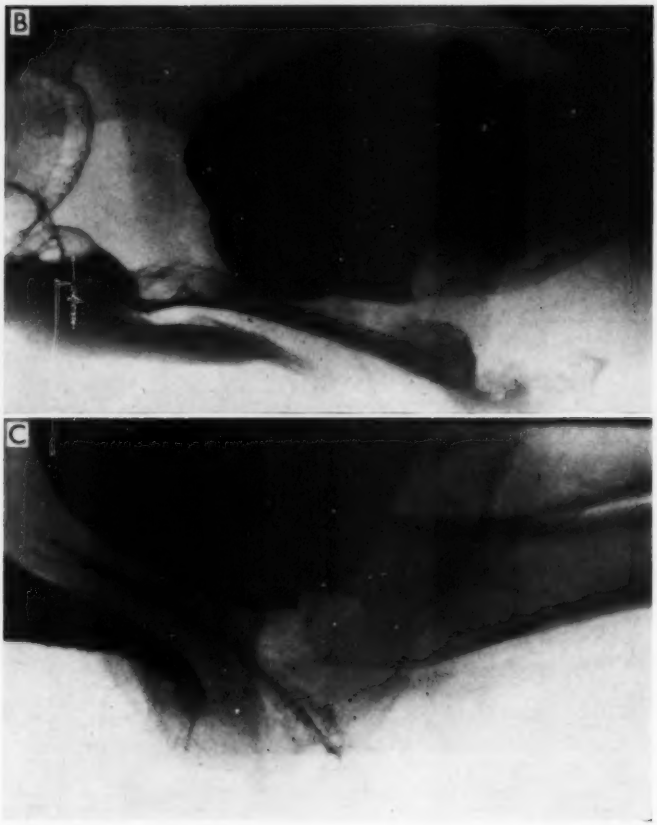

FIG. 1

Lateral barium cystograms with the patient at rest.

(*b*) A parous patient, aged 35, with stress incontinence of urine. Note general similarity with Fig. 1(*a*). In this patient an indentation is shown in the middle third of the bladder base, which we believe represents the junction of the trigone with the detrusor.

(*c*) A parous patient, aged 53, with stress incontinence of urine. Similar to Fig. 1(*b*). The anterior border of the bladder above the internal meatus shows a bulge forwards. The area usually visualized in the rapid serial examinations is shown.

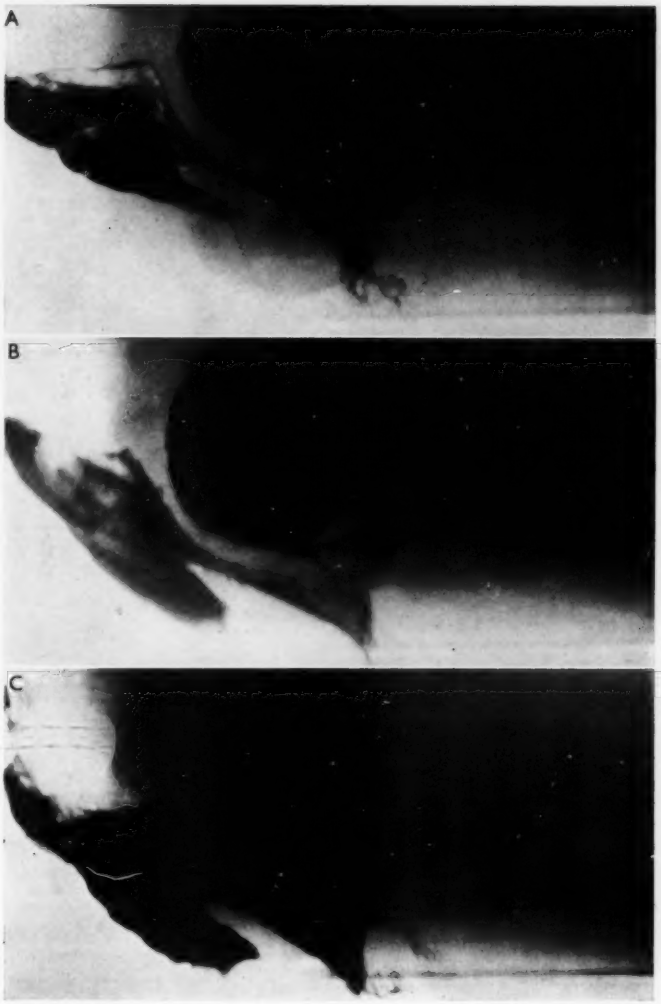

FIG. 2

Lateral barium cystogram of a parous patient, aged 43, with no urinary symptoms.

(*a*) *At rest*. The barium outline of the rectum and vagina are shown in relation to the bladder base. A "beak" of barium projects into the internal meatus at the junction of the anterior border and the bladder base.

(*b*) *On straining*. There is marked descent of the bladder base and forward movement of the internal meatus. The "beak" of barium is more marked, and longer than is usually found.

(*c*) *On voiding*. The contours of the urethra are as described in the text and similar to Fig. 3.

FIG. 3

Lateral cystogram of a parous patient, aged 47, with stress incontinence of urine, during voiding. The contours of the urethra are shown as described in the text. The anterior urethrovesical angle is prominent; the posterior urethrovesical angle, present at the commencement of voiding, is virtually lost at this stage. An indentation in the bladder base indicates the junction of the detrusor with the trigone.

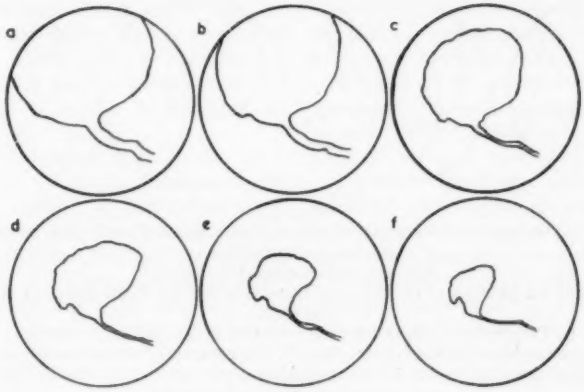

FIG. 4

Tracings from 6 serial films of a normal parous patient aged 25 during voiding.

(In this and subsequent Figures the diameter of the circle represents 12 cm.)

(*a*) Voiding established; a normal posterior urethrovesical angle is present. At zero time.

(*b*) An indentation has appeared in the trigone area. There has been some narrowing of the whole urethra. 1·5 seconds.

(*c*) The bladder is approximately spherical and the contours of the detrusor are crenated. There is further narrowing of the urethra. 3 seconds.

(*d*) and (*e*) and (*f*) Progressive emptying of the bladder and narrowing of the urethra; the trigone area remains relatively prominent, its posterior margin rising. The bladder is almost empty. 5, 6·5 and 8 seconds respectively.

FIG. 5

A series showing the urethra and bladder base during the completion of voiding in a normal nulliparous patient aged 36.

(*a*) The trigone area is smooth, the detrusor behind it is crenated. There is a good posterior urethrovesical angle. At zero time.

(*b*) An indentation has appeared in the trigone area. 4 seconds.

(*c*) and (*d*) Progressive narrowing of the urethra is shown with an indentation in the trigone region. In this subject this indentation is unusually close to the internal meatus. 11 and 15 seconds respectively.

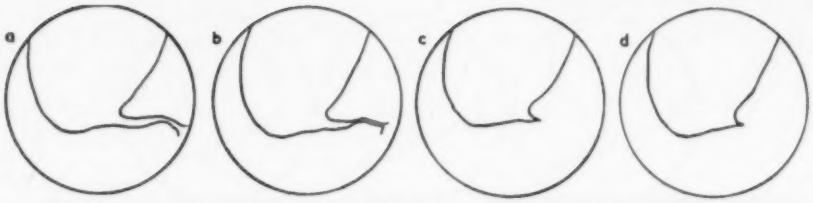

FIG. 6

A series of 4 serial tracings in a normal parous patient aged 36 showing involuntary interruption of the stream during voiding.

(*a*) The urethra filled. Zero time.

(*b*) Narrowing at the junction of the proximal two-thirds and the distal one-third of the urethra. 3 seconds.

(*c*) Progressive obliteration spreading towards the bladder. 5 seconds.

(*d*) Further reduction in size of the residual "beak". The contents of the proximal two-thirds of the urethra have been returned to the bladder. Minimal movement of the bladder base and vagina and rectum has occurred. 9 seconds.

Following this normal voiding was resumed.

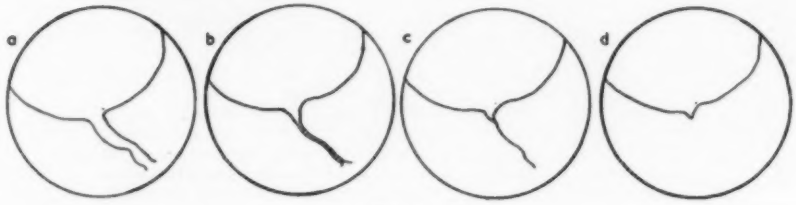

FIG. 7

Voluntary interruption of the stream in a normal parous patient aged 25. Further tracings from the same patient illustrated in Fig. 4.

(*a*) Established stream. Zero.

(*b*) General narrowing of the distal two-thirds of the urethra. 0·5 second.

(*c*) Further narrowing. 0·75 second.

(*d*) Obliteration of the urethra except for the proximal "beak" of contrast medium at the internal meatus. 1·25 seconds.

the process of urethral closure was similar, but there was also elevation of the bladder, vagina and rectum, with straightening of the urethra, which seemed to be associated with considerable contraction of the perineal muscles (Figs. 8 and 11).

Appearances in the 16 Patients with Stress Incontinence

These patients (Table I) suffered from stress incontinence of urine of a varying degree. They showed many variations in the shape of the bladder and the urethra, the significance of which is not yet understood. The position of the internal meatus at rest was indicated by a small beak of barium in 5 of the patients; there was no indication of its position in the others. On coughing or straining, contrast medium was seen to enter the urethra to a varying degree. In 2 of the patients the urethra filled completely. In the others, a smaller or larger beak of contrast medium was visible and was returned into the bladder on ceasing to strain or cough; this beak reached various distances along the urethra, either to or beyond the proximal third. The appearance of the urethra was basically similar to that seen while beginning normal voiding. When subjects with stress incontinence of urine

interrupted the stream, either voluntarily or involuntarily, they did so in a similar manner to normal subjects. There was a considerable descent of the bladder base in the region of the internal meatus in 9 of the 16 subjects on straining or coughing.

A posterior-urethrovesical angle of less than 180° was present in 13 of the patients at the onset and during voiding, although this angle was lost later during voiding in some of the patients. In one patient, the angle was absent from the beginning of voiding and in the other 2 the commencement of the act was not observed.

Distension of the Urethra

In both groups of patients there were several in whom the urethra varied in diameter throughout its length at different times during voiding. The degree of distension appeared to vary with the rate of voiding and the presence or absence of any urethral obstruction.

When 2 of the subjects were examined with and without a catheter in the urethra, it could be seen that the catheter tended to straighten the urethra. In one parous subject the catheter appeared to block the external meatus during straining and voiding, producing considerable distension of the urethra; without the catheter the urethra appeared much narrower (Fig. 9).

Slight obstruction to the urethra may cause proximal distension to a marked degree, as occurred in the patient who had had a previous modified Aldridge sling operation. The proximal half of the urethra was greatly distended on voiding but towards the conclusion of the act became much narrower, and emptied of its contents (Fig. 10).

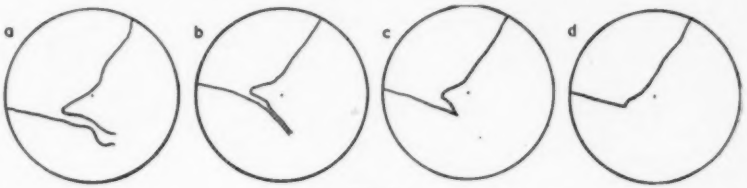

FIG. 8

Interruption of the stream on command in a normal parous patient aged 29. A series of 4 tracings showing elevation of the bladder base with narrowing and obliteration of the urethra.
(*a*) Established stream. Zero.
(*b*) The beginning of interruption of the stream; elevation of the bladder base and narrowing of the distal urethra. 0·75 second.
(*c*) and (*d*) Obliteration of the proximal urethra, with return of its contents to the bladder. 6·75 and 11·75 seconds respectively.

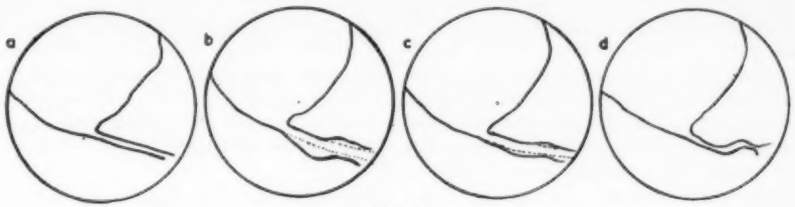

FIG. 9

A series of tracings of 4 films illustrating the effect of a catheter *in situ*, in a parous patient with slight stress incontinence of urine, aged 34.
(*a*) Voiding through the catheter.
(*b*) Distension of the urethra on straining, with voiding through and around the catheter.
(*c*) Less distension, still voiding through and around the catheter.
(*d*) Voiding without the catheter.

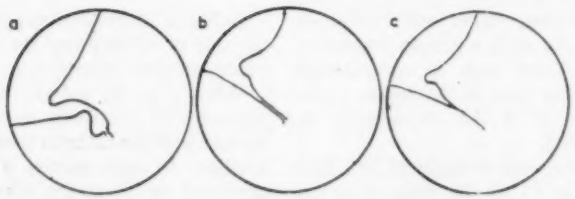

FIG. 11
Three tracings showing interruption of the stream on command in a normal nulliparous patient, aged 45.
(*a*) The distended urethra during voiding; note the narrow external meatus and distended distal one-third of the urethra. Zero.
(*b*) and (*c*) Marked elevation of the bladder and stretching of the urethra on voluntary interruption of the stream. The urethra narrows distally and only gradually does the obliteration spread to the bladder. 0·5 and 2·5 seconds respectively.

In one normal nulliparous subject the external meatus itself appeared to be narrow, with the result that the urethra, immediately proximal to the external meatus, became dilated during voiding (Fig. 11).

DISCUSSION

Contrast Media

Apart from the organic urographic contrast media containing iodine, a variety of methods for demonstrating the bladder and urethra have been used, including the following:

Sodium iodide (Thomsen, 1932)
Metallic chain (Stevens and Smith, 1937; Hodgkinson and Doub, 1953)
Foley catheter (Ball, 1950)
Catheters and iodized oil (Roberts, 1952)
Barium sulphate suspension (Nordenström, 1952)

We agree with Nordenström that barium sulphate is cheaper and gives a better contrast than the iodine-containing compounds. Semi-rigid or other urethral markers may distort or give a false impression of the shape and position of the urethra or vagina. A stable suspension of barium sulphate should be used which does not sediment or block the urethra even if there is considerable delay between the filling of the bladder and taking the radiographs. In the 50 per cent dilution used, the suspension was sufficiently fluid to be passed naturally. No complications developed using this medium in any of the patients who had had "still" cystograms taken during the preliminary investigation, or in any of the present series. At the beginning of the investigation the bladder was washed out after cystography but later this was found to be unnecessary. The subjects were encouraged to drink plenty of fluid.

The vagina and rectum are best shown without the aid of solid bodies. It was considered important to outline these, to reveal the presence of a pouch of Douglas hernia or rectocele, and to show the relationship of the urethra to the vagina.

Radiological Method

Still radiography for the study of a sequence of movements is obviously open to error, as also are serial methods when the films are exposed at too slow a rate or over too short a period. Our own work may suffer in this respect because we deliberately limited the total dose of radiation. The use of an X-ray image intensifier made lateral views possible with a relatively low radiation dose. We considered the antero-posterior projection of limited value because of the foreshortening and superimposition of the urethra on the region of the bladder neck while straining or voiding.

The Anatomy of the Bladder and Urethra

The account given above of the anatomy of the bladder is based on the radiographic appearances of those women who gave no history of stress incontinence or other urinary symptoms. There is no means of knowing how many of these subjects were entirely normal. They were of

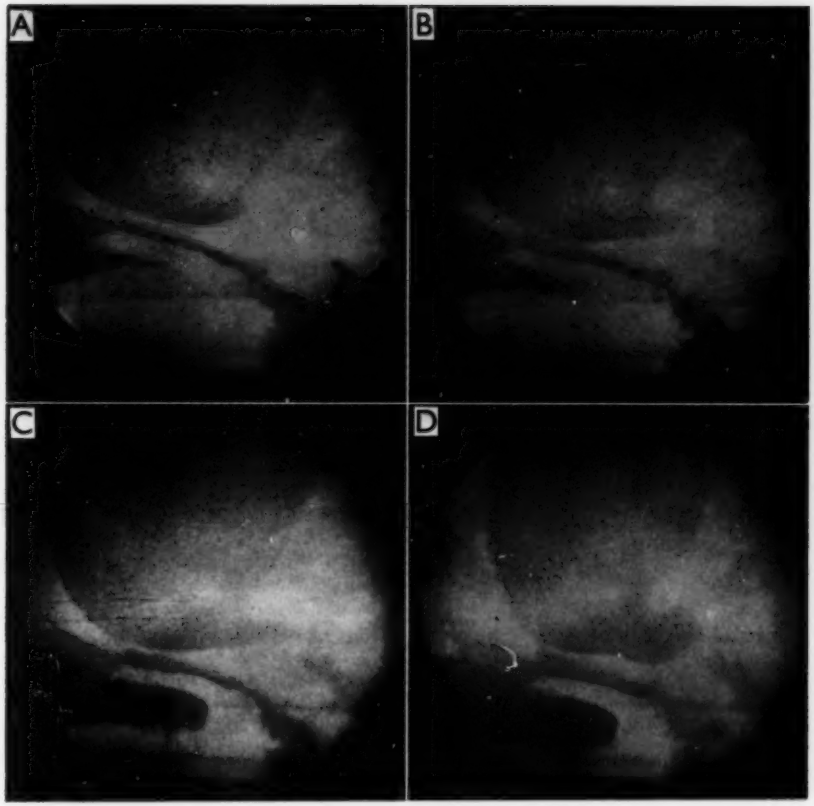

FIG. 10

Four films from a patient, aged 48, who had had a previous Aldridge Sling type of operation for nulliparous stress incontinence of urine.

(*a*), (*b*), (*c*) and (*d*) Filling of the urethra at the commencement of voiding, with gross proximal distension. The distended urethra, however, was capable of obliterating its lumen at the end of voiding.

different age groups; most had borne children. It is probable that some may have acquired some weakness of the muscles, ligaments and fascial supports of the pelvic floor, which may have influenced the normal anatomical relationship. Thus the material is really inadequate to describe the appearance in the normal young nulliparous adult.

There is considerable variation in the views held by different workers on the radiological anatomy of the female urethra. The degree of distension of the various portions of the urethra may vary according to circumstances, and at different stages of voiding. The appearance of the normal urethra by rapid serial radiographs in general conformed to the description given by Nordenström (1952). Jeffcoate and Roberts (1952) concluded that the urethra lies in a straight line as shown by a catheter. But even a soft catheter does not necessarily indicate the true path of the urethra and can distort the neck of the bladder. Only in one of the 11 normal patients did the base and a small portion of the anterior wall of the bladder appear in a straight line. In the other subjects the internal meatus appeared on the rounded corner at the junction of the base and the anterior wall of the bladder.

De Azevedo and Cabelo Campos (1932) stated that the continuity of the urethra with the bladder in a rounded line instead of the normal angle-shaped separation was almost always accompanied by incontinence of urine. They called this "the sign of the neck". Stevens and Smith disagreed with this view, and in all but one of our patients suffering from stress incontinence of urine an angle was present at the onset of voiding. Conversely this angle was absent in one of our normal patients.

Thomsen (1932) described a bend in the normal urethra, which disappeared or was reversed in direction in patients with stress incontinence. We have not been able to correlate any alteration in angles between the urethra and the bladder base, or in the urethra itself, with symptoms. Descent of the bladder neck on straining, which was described by Millin and Read (1948) as a feature of stress incontinence, was present in equal proportions in patients examined by rapid serial radiography whether they suffered from stress incontinence or not.

Normal Voiding of Urine

Muellner (1951), as a result of fluoroscopic studies, came to the conclusion that normal voiding was begun by the descent and opening of the internal sphincter, and that this was due to the relaxation of the pubo-coccygeus, associated with a raised intra-abdominal pressure caused by the contraction of the abdominal muscles and fixation of the diaphragm. However, Denny-Brown and Robertson (1935) had demonstrated by pressure measurements in 3 normal *male* subjects that normal voiding was begun by contraction of the detrusor and that then the internal meatus opened as the internal sphincter relaxed. Hinman *et al.* (1954) after serial roentgenographic antero-posterior studies in normal nulliparous women, supported this view. It is therefore probable that fluoroscopy does not give the eye sufficient time to appreciate rapidly moving events.

Closure of the Urethra on Complete Emptying of the Bladder

Roberts (1953) has stated that at the end of micturition the internal sphincter closed and urethral tone was restored; the last few drops of urine were expelled by the deliberate contraction of the voluntary muscle around the urethra. It would seem unlikely that the internal sphincter closes first. It is difficult to study this point, however, because of the narrowing of the urethra, and the consequent reduction of contrast in the last few drops of fluid expelled.

Closure of the Urethra During Interruption of the Stream

The careful work of Denny-Brown and Robertson (1935) on the closure of the urethra in the male showed that the external (voluntary) sphincter was maintained in closed posture and only opened after the opening of the internal (involuntary) sphincter; it closed spontaneously at the end of voiding before the internal sphincter had closed. This has been confirmed radiologically by Morales and Romanus (1953) in the male, and by Hinman *et al.* (1954), by antero-posterior studies, in the female.

Muellner (1951) using fluoroscopy concluded that deliberate interruption of the urinary stream was initiated by contraction of the entire levator

ani: "This sharply raises the bladder neck and causes the internal sphincter to snap shut. The urinary stream is therefore interrupted at the internal sphincter and one never sees the stream to be pinched off by the external sphincter when normal urination is deliberately stopped." During closure, the urethra may be emptied of its contents in less than half a second, the movement being too rapid for observation during fluoroscopy.

However, Roberts (1953) states that "If because of modesty or interrupted stream, the detrusor contracts, the urethra dilates as low as the triangular ligament but no further. The compressor urethrae can therefore successfully withstand the force exerted by the detrusor. If she is asked to stop voiding the stream is interrupted here and the urethra remains dilated for some time." It is not clear how interruption of the stream is related to contraction of the detrusor. It may be that the still radiographic technique has shown a single phase of the normal mechanism of closure of the urethra. Nordenström (1953) related delayed closure of the internal sphincter to incontinence of urine in women.

Rapid serial radiography in our limited series of subjects showed that the external sphincter closed first and that the urethra was emptied by expulsion of most of its contents into the bladder before the internal sphincter contracted. The last few drops of urine appeared to be expelled outwardly from the distal third of the urethra. The contents of the proximal two-thirds were expressed retrogradely into the bladder. Involuntary stoppage of the stream would appear to be due to the contracting of muscles intimately related to the wall of the urethra, since this occurs without any elevation of the bladder base or urethra. During voluntary stoppage these actions were reinforced by contraction of the muscles of the pelvic floor, which elevated the bladder, vagina and rectum. The same observations were made during voluntary and involuntary cessation of voiding in the 10 subjects with stress incontinence of urine who had had no previous operation.

It is generally believed that the urethra is adherent to or embedded in the anterior vaginal wall. Yet radiographically the urethra, except at the distal end, and the bladder base are often at some distance from the closed vagina and during voiding may move independently of the latter.

Further work will be required to ascertain the nature of the defect in patients with stress incontinence of urine. This defect appears to be related to the sphincters and the urethral muscle, and not to the posterior urethrovesical angle or to any angulation of the urethra itself. It is possible that the reflux of urine on closure of the urethra may have some bearing on the frequency of cystitis in women and girls.

Summary

The female urethra has been investigated by rapid serial radiography in the lateral view, using an image intensifier, in 11 women without, and in 16 women with, stress incontinence of urine. The appearances of the bladder base and the urethra and their relationship to the vagina have been described during some of the phases of voiding and interruption of the stream.

The following conclusions have been drawn:

(1) The urethra appears to be empty at rest except for a small "beak" of contrast medium projecting into the internal meatus.

(2) During straining the "beak" may increase slightly; in patients suffering from stress incontinence of urine the urethra may fill to a varying degree. On ceasing to strain the urethral contents are returned to the bladder.

(3) With interruption of the stream the external sphincter closes first and the contents of the proximal two-thirds of the urethra are returned to the bladder by progressive obliteration of the lumen.

(4) A posterior urethrovesical angle of less than 180 degrees is usually present at the beginning of voiding in patients with or without stress incontinence of urine.

Acknowledgments

Our thanks are due to the Director and Staff of the Area Department of Obstetrics and Gynaecology, Oxford, where this work was initiated, and to the Staff of the Department of Radiology, Oxford United Hospitals, for their co-operation. We also wish to thank Miss E. Emrys-Roberts and Mr. M. S. Tuckey for valuable technical assistance.

Approximately 40 "still" cystograms taken at the Post Graduate Institute of Obstetrics and Gynaecology were also studied and for these our thanks are due to Dr. R. E. Steiner, Mr. C. D. Read, Professor J. C. McClure Browne and their assistants.

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THE RESULTS OF THE ALDRIDGE SLING OPERATION FOR STRESS INCONTINENCE

BY

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CONSIDERING the interest taken in the problem of stress incontinence of urine during recent years and in its treatment by various types of urethral sling and urethrocystopexy, as well as by more bizarre procedures, it is remarkable how few are the detailed reports of the results of such operations. Risks and complications such as vesical and urethral fistulae; sloughing of the urethra; partial or complete obstruction of the urethra; infection of the retropubic cellular tissue; loss of the micturition reflex; chronic over distension of the bladder; and chronic urinary infection are all mentioned but there is no clear statement as to how real they are. Moreover, the results as regards restoration of bladder control, even when given in figures, are rarely related to the time interval after operation. Sometimes it would appear that they are assessed within a few months of the operation. This is an important consideration because it is generally recognized in regard to anterior colporrhaphy for stress incontinence of urine that the results cannot be properly judged until 2 years have elapsed. It is also relevant to comment that an assessment based on evidence obtained other than by personal interview and examination of the patient is unreliable.

Aldridge described his modification of earlier urethral sling operations in 1942 and, being impressed with its possibilities, I determined to try it out. The first opportunity occurred in January, 1944, the patient being one of Sir Arthur Gemmell's and he taking a share in the operation. Including this case the Aldridge sling operation was carried out 45 times on 44 patients up to the end of 1954. It was advised but refused in one further case. This makes an average of 4 cases per year during 11 years and serves to indicate that the place for this type of operation in an unselected gynaecological practice is only a small one.

Despite the later introduction and popularity of other operative procedures for stress incontinence of urine, it was decided to adhere to the Aldridge sling operation in all cases where something more than anterior colporrhaphy was indicated. This decision was made for the following reasons:

(i) The results in the early cases were good, and there had been no serious post-operative complications such as were being described for other sling procedures.

(ii) In theory the combined abdominal and vaginal approach appeared to offer safety and to make the placing and tightening of the sling more exact.

(iii) Loyalty to one operation made it possible to collect a sufficiently large number of cases which could be observed for a sufficiently long period of time to permit reliable conclusions to be drawn in regard to one operation. This seemed preferable to the gathering of impressions from a small experience of several operations.

MATERIAL

The 44 women operated on were all multiparous and all were carefully investigated to ensure that their complaint was true stress incontinence of a degree severe enough to justify the operation. In addition to the usual clinical approach, cystoscopy, cystography, intravenous pyelography and cystometry were carried out in the majority. Lateral cystourethrography as described by Roberts (1952) and Jeffcoate and Roberts (1952) was performed 54 times in 37 women, either before or after operation or both.

The women concerned had had previous operations for stress incontinence as follows:

3 previous vaginal plastic operations	3
2 previous vaginal plastic operations	10
1 previous vaginal plastic operation (combined with vaginal hysterectomy in 2)	23
Interposition operation	1
No previous operations	7

One patient who had 2 previous vaginal plastic procedures had an Aldridge sling operation attempted but not completed. Stress incontinence returned within 2 months and the operation was repeated 4 years later. So the total number of operations reported here is 45.

Those women who had had no previous operation for stress incontinence were treated by means of sling as a primary procedure on the grounds that they had no evidence of cystocele or prolapse of any kind, and that the anatomical deformity revealed by cystourethrography suggested that a simple procedure was unlikely to be successful. They were all late in the series and the choice of operation was governed by earlier experience of similar cases.

Details of Operation

Thirty-five of the 45 operations were carried out by the writer, 10 by assistants. The technique followed almost exactly that described by Aldridge (1942). The fascial strips were sutured together with *plain* catgut No. 1 and overlapped if they were long enough. They were not fixed to the vaginal epithelium. Following operation a self-retaining catheter was inserted into the bladder for 5 days and released every 3 or 4 hours. The patient was assisted out of bed on the first day and was thereafter encouraged to take more and more exercise. Penicillin and sulphonamides were administered routinely for 5 days after operation.

Three operations were clouded by technical errors. In one, a demonstration by the writer in unfamiliar surroundings, a dilated urethra with unusually thin walls was opened by the initial vaginal incision. It was closed and it fortunately healed without difficulty, the final result being a cure. In the second an assistant opened the bladder in bringing down a fascial strip and also found the strips too short to suture together under the urethra. The bladder was closed and the ends of fascia merely sutured to its sides. The patient made an uncomplicated recovery and remained continent for 2½ years when her symptoms returned and became as troublesome as ever. The third was again marred by failure of an assistant to cut strips sufficiently long and so incontinence persisted until the operation was repeated later.

Post-operative Complications

Mortality. One patient died from pulmonary embolism at the end of the first week. Post-mortem examination showed that the operation field was satisfactory.

Incisions. All healed by first intention. There was no evidence of significant infection of the operation field in any case.

Bladder function. As mentioned previously the bladder was emptied by catheter for 5 days after operation in all cases. Thereafter most women experienced a little trouble in emptying the bladder and 10 had to be catheterized for 2 or 3 more days. In 2 others retention persisted until 3 weeks after operation. A few women found it difficult to void urine unless they adopted unusual postures such as standing, bending forwards, or lying flat. Minor difficulty of this kind, enough to cause amusement rather than embarrassment, lasted for several months in 3 cases and it then slowly disappeared. It still persists 6½ years after operation in 1 woman. Overdistension of the bladder and loss of the micturition reflex was found 1 year after operation in 2 women, but responded well to physiotherapy.

There were no cases of serious urinary tract infection although most women probably suffered a minor degree of post-operative cystitis.

Follow-up of Cases

Allowing for the 1 death, 43 women (44 operations) were available for post-operative study. All except 1 were examined and questioned in late 1954 or early 1955. One patient was examined by Sir Arthur Gemmell, a second by arrangement with Professor Harvey Evers; the remainder by the writer or a member of his staff. The 1 patient not examined is living abroad, but, 1 year after operation, reports that she is completely cured.

The approximate time which elapsed between the operation and the present review was as follows:

6 months ..	1 case
1 year	13 cases
2 years	3 cases
3 years	3 cases
4 years	3 cases
5 years	8 cases
6 years	4 cases
7 years	3 cases
8 years	3 cases
9 years	1 case
10 years and over	2 cases

Results

The results of the first 25 operations were assessed and recorded in 1952 (Jeffcoate and Roberts). Then as now a critical standpoint was adopted but on review the original assessment of 1 case has had to be altered. In the earlier publication it was noted that this woman suffered a return of slight incontinence 6 years after operation, so she was recorded as only "improved". Four years later this patient reports that after a few months bladder control was again restored to normal and has remained so. She is therefore now assessed as cured.

Overall results (6 months to 11 years follow-up on 44 operations).

Cured	38 (86 per cent)
Improved considerably ..	3
Failed	3
	44 operations (43 patients)

It will be seen that, to date, only 3 operations are regarded as having failed. Two of these operations were unsatisfactory in that the fascial strips were so short that the sling was never completed. In 1 of these cases the operation was later repeated and remains successful after 1 year. It may be noted that the repeat operation offered no special technical difficulties, either in the cutting of fascial strips or in the retropubic dissection. There was only 1 operation technically satisfactory which resulted in failure, incontinence returning 6 months later. This was followed by a Marshall Marchetti Kranz operation which proved equally unsuccessful.

Results in relation to period of follow-up. One of the surprising results of this enquiry is that it appears to show that, unlike anterior colporrhaphy, a fascial sling operation is reasonably permanent in its effects. If the result is good at the end of 6 months or 1 year, then it is likely to remain so. At any rate, after that time the patient is not likely to return to her former state of misery even though bladder control does not remain perfect. Partial or complete relapse occurred within 6 months of operation in 3 cases, 1 year after operation in 1 case, 2½ years after operation in 1 case, and 4½ years after operation in 1 case. No patient has so far suffered a return of symptoms more than 4½ years after operation except the one previously mentioned, who, now assessed as cured, did have slight incontinence for a few months 6 years after an operation carried out 10 years ago.

If the cases had been assessed 6 months after operation the results would have been:

Cured 41. Improved 1. Failed 2.

If they had been assessed at 2 years the results would have been:

Cured 27. Improved 1. Failed 2.

If they had been assessed at 5 years the results would have been:

Cured 16. Improved 2. Failed 3.

Late sequelae. The operations were remarkably free from late complications. Indeed, all the cured women are extraordinarily grateful for their return to normal existence. Until one interviews women cured of stress incontinence it is difficult to appreciate how distressing is the original symptom. It is only when their confidence in their bladder is restored that they are prepared to recount how for years they never could wear thin frocks, that they always dressed in black, that they dare not go out without an overcoat or raincoat, that their whole mode of life was moulded round their complaint, and that this usually meant severing all social contacts and remaining indoors except for urgent matters such as the family shopping.

(1) *Bladder Function*

Some disturbance which persisted in 3 women is already described above. Other than these a

few women admitted to some urgency of micturition but only when they were asked a leading question and then they made light of it as causing negligible inconvenience.

(2) *Hernia*

In view of the fact that it is sometimes alleged that the Aldridge operation results in permanent weakening of the abdominal wall and in hernia formation, special attention was paid to this at the time of follow-up. Not one patient had noticed any abnormality so far as the abdominal wall was concerned—no pain, no swelling. On examination a hernia was not found in any, although in 2 women there was a slight diffuse bulge on coughing at the outer end of the fascial incision. Neither of them was aware of this.

Conclusion

The object of this communication is merely to set on record the results of a particular operation carried out in one unit. They require little elaboration. The operation resulted in the death of one woman from embolism, but this tragedy might well have occurred with any type of operation for stress incontinence and is not necessarily attributable to the Aldridge sling technique. Apart from this the results would appear to indicate that the value of the operation in properly selected cases is of a high order. Two out of 3 failures occurred in cases in which the operation was technically at fault and this emphasizes that it is a procedure which requires some experience if it is to be safe and reliable. Even so, providing that reasonable care is taken over technical matters, the operation is comparatively free from the risks and disadvantages which it is alleged to have. Moreover, it gives results which compare favourably with those of any other method for treatment of long standing stress incontinence, and they are generally long lasting.

I am grateful to Sir Arthur Gemmell and Professor H. Harvey Evers for their kindly cooperation mentioned in the text, and to Dr. Henry Roberts for his help with the compilation of records and the assessment of cases before and after operation.

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THE VALUE OF ANTENATAL EXERCISES

BY

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ALTHOUGH much time and expense are being devoted to antenatal physiotherapy throughout the British Isles, its true value is unknown. In some clinics where the obstetricians favour relaxation and exercises, they are supervised with great loyalty and enthusiasm by medical officers, midwives and physiotherapists, in others, where the obstetricians are luke-warm, they are carried out perfunctorily, whilst in others yet again, where the obstetricians are antagonistic, they are not practised at all. This, surely, is unsatisfactory—if the exercises are of value efforts should be made to perfect and popularize them, and, on the other hand, if they are of no value they should be abandoned. All obstetricians agree that they prefer their patients to be calm, reassured, and to show no fear towards their labours, but they disagree whether these states can be produced by a carefully systematized programme of educational exercises, even if they are supplemented by helpful "talks" and tuition classes. Do these exert a beneficial influence, shown by an increased number of normal vertex deliveries, or by shorter, less painful labours, with fewer complications to mother and child? Some controlled experiments have been carried out to investigate this question, but usually the number of patients involved has been small and the results equivocal. Obstetricians have in the main tried to clarify two points: firstly, the effect of exercises on the duration of labour and the incidence of complications, and secondly, their influence on the amount of pain experienced. This paper is an attempt to clarify the former of these issues, being an analysis of the deliveries occurring during one calendar year at the West Middlesex and Chiswick Maternity Hospitals, which have been classified and compared according as to whether or not the patients attended antenatal tuition and exercise classes.

The amount of pain borne by these two groups of patients has not been assessed, for the simple reason that there is no adequate objective method of measuring the pain of labour. The technique sometimes employed, of contrasting the dosages of analgesic drugs given to patients when in labour, has not been used; this is because it is considered that exercised patients often refuse drugs, feeling this is what they are expected to do, whilst the amount of sedation offered depends upon the attendant in charge of the labour, who may have been any one of a large obstetric staff during the year the investigation has been in progress. Similarly, the patient's description of the amount of pain she has borne, or its estimation by the attendant midwife, is felt to be too unreliable to serve as a basis for accurate assessment.

PREVIOUS INVESTIGATIONS

It has been thought for many centuries that exercises are beneficial to the expectant mother. Plutarch in his life of Lycurgus described how the women of Sparta from the ninth century before Christ—

> "... should harden their bodies with exercise of running, wrestling, throwing the bar, and casting the dart ... and that they by gathering strength thus by exercises, should more easily away with the pains of child bearing."*

But it is only since the first World War that obstetricians have placed much value upon exercises as a prophylaxis against prolonged and abnormal labour. Read (1933) stated that "if (relaxation) is carried out even to a relatively incomplete extent benefit will be obvious ...

* North's translation.

for labour without tension is almost invariably a quick labour". He emphasized his opinion that "complete relaxation . . . is the secret of a calm, quick labour" adding that, with quiet relaxation, the placenta is rarely slow to separate and a torn perineum is a personal disgrace. Failure, he stated, is "due to the mentality amongst modern cultured women, where no influence can bend the rigid egoism of their ignorance". Secher (1934) referred to reports of particularly short labours in well-trained women, whilst Vaughan (1942) held antenatal exercise classes and the results seem to have been satisfactory to all concerned. In 1948 an Obstetrical Research Committee reported an investigation carried out in New Zealand, which was to a large extent an extension of the work done by Dawson (1941). The classes were designed for physically untrained women living sedentary lives, and consisted of relaxation and exercises to help the second stage. It concluded that primigravidae under 30 who were not exercised required forceps more frequently than those who were, whilst there were more premature deliveries among the unexercised group. The committee thought the exercises were of value because the patient was reassured by the interest shown in her welfare, she became accustomed to the hospital and the staff present at her delivery, and was encouraged to do something to help herself. Thoms (1950) surveyed 1,500 mothers during a period of three years, and concluded that, after a course of antenatal exercises devoted to relaxation and labour techniques, labour was shorter, there was less abnormal bleeding, less post-partum fatigue, and less asphyxia neonatorum. At a meeting held in the Royal Society of Medicine, London, in 1950, Bourne advocated physical exercises because he thought the patient gained a feeling of confidence in the value of her own positive efforts, and Nixon stated he had a physiotherapist present at the antenatal classes to teach various types of breathing, posture and exercises. Von Rütte (1951) found little benefit resulting from exercises, except for a shortened period of exhaustion and a rapid recovery after delivery; he also claimed that no complications, such as premature births or haemorrhages, were caused by the exercises. Heardman (1951), who has won many converts to her system of exercising pregnant patients, stated that ". . . deviations may right themselves or be prevented by a trained (patient) . . . in a way that is not so liable to occur with an uninstructed, apprehensive one".

A more rational approach to the question of exercises has, however, damped the first enthusiasms. Rodway (1947) compared the labours of 340 primigravid patients with the same number of controls and found no appreciable differences. Whilst still adhering to their theoretical efficacy, she ascribed their failure to infrequency of instruction and lack of supervision in labour by trained instructors. Wrigley (1950) reported a series of 140 patients and found the results to be almost identical in the exercised and control groups. A further 106 patients who attended his physiotherapy classes were also given psychological preparation for labour, but the results were identical with a similar number of controls. Clayton (1952) expressed his personal disbelief in the value of relaxation. Roberts, Wootton, Kane and Harnett (1953) found no difference in the distribution pattern of the lengths of the first and second stages of labour in exercised and unexercised patients.

The Present Investigation

Briefly the investigation is based upon the booked deliveries occurring in the West-Middlesex and Chiswick Maternity Hospitals during 1953, a total number of 2,994. Of these 319 were excluded because of major mechanical hazards, leaving 2,675 patients for analysis. Of this number 2,475 had spontaneous vertex deliveries, and it was felt that a group of patients of this size, some of whom were prepared for labour by physiotherapy, was a suitable number to show whether this form of antenatal preparation is of any value.

Antenatal Classes

When patients are booked at the antenatal clinic they are invited to attend a mothers' class, at which the whole obstetric team combines to give them talks and demonstrations relating to pregnancy and labour, and to mothercraft. They are there addressed by a consultant obstetrician, midwives, almoners,

and a dietician; at these talks the importance of antenatal exercises has (up to the present) been stressed, and a physiotherapist has collected volunteers to attend classes throughout pregnancy. Other patients are invited directly from the clinic, without necessarily attending the obstetricians' lectures. Relaxation and exercise classes are held twice weekly, about 12 patients coming to each session. They are instructed by a trained physiotherapist (who is also a midwife) and her staff, the midwives freely co-operating so that the technique taught may be accurately reproduced later in the labour ward. Patients attend for instruction once a fortnight, and are enjoined to practise the exercises in their own homes. Explanatory pamphlets are supplied when it is thought they will be helpful.

It is unnecessary to describe fully the techniques which are taught, but they are based upon those advocated by Mrs. Heardman, especial attention being devoted to correct breathing, relaxation, and exercise of the muscles used during the second stage of labour. The assumption of postures adopted during delivery is also practised so that they will not appear strange to the patients when they are in labour. During these physical preparations time is also given to psychological training, and whilst not minimizing the discomforts of labour and the need for hard physical work, every means is taken of educating the patients, banishing fear, and giving them confidence both in themselves and their attendants.

Classification of Patients

This investigation is similar to those previously carried out in that a comparison is drawn between the labours of trained and untrained patients, but it differs in that it was not envisaged whilst the training and the deliveries were in progress, being begun in fact only after the expiration of the year to which all the facts and figures relate.

To make the comparison valid, it is necessary to match patients of the same parity and age groups. The sample of 2,675 patients comprises 1,364 (51 per cent) primigravidae and 1,311 (49 per cent) multiparae. Table I shows the primigravidae classified into four age groups, there being 191 aged under 20, 974 between 20 and 29, 188 between 30 and 39, and 11 over 40. The table also shows that 1,234 (90·5 per cent) had normal vertex deliveries, 20 (1·5 per cent) were delivered spontaneously face to pubes, 70 (5·1 per cent) by forceps, and 40 (2·9 per cent) breech first.

The multiparae are classified in the same way in Table II. In this group there were 13 aged under 20, 740 between 20 and 29, 492 between 30 and 39, and 66 over 40. It will also be seen that 1,241 (94·6 per cent) had normal vertex deliveries, 31 (2·4 per cent) were delivered spontaneously face to pubes, 8 (0·6 per cent) by forceps, and 31 (2·4 per cent) breech first.

(a) *The Primigravidae.* Amongst the 1,364 primigravidae, 245 (17·9 per cent) attended exercise classes, the number and percentage of each group being given in Table III. This shows that of the 1,234 patients who had normal vertex deliveries, 221 (17·9 per cent) had practised exercises, whilst of those delivered face to pubes 4 (20·0 per cent), with forceps 11 (15·7 per cent), and breech first 9 (22·5 per cent) did so. In each group, therefore, about one-fifth of the patients availed themselves of antenatal exercises.

TABLE I
Classification of Primigravidae According to Age and Type of Delivery

Age	Normal Vertex Delivery	Spontaneous Face to Pubes Delivery	Forceps Extraction	Breech Delivery	Total
Under 20	183	4	1	3	191
20 to 29	889	11	41	33	974
30 to 39	152	5	27	4	188
Over 40	10	0	1	0	11
Total	1,234	20	70	40	1,364

TABLE II
Classification of Multiparae According to Age and Type of Delivery

Age	Normal Vertex Delivery	Spontaneous Face to Pubes Delivery	Forceps Extraction	Breech Delivery	Total
Under 20	13	0	0	0	13
20 to 29	704	17	3	16	740
30 to 39	464	14	3	11	492
Over 40	60	0	2	4	66
Total	1,241	31	8	31	1,311

TABLE III
Primigravidae Attending Exercise Classes

Age	Normal Vertex Delivery			Spontaneous Face to Pubes Delivery			Forceps Extraction			Breech Delivery			Total		
	With Ex.	No Ex.	Per cent	With Ex.	No Ex.	Per cent	With Ex.	No Ex.	Per cent	With Ex.	No Ex.	Per cent	With Ex.	No Ex.	Per cent
Under 20 ..	6	177	3·3	0	4	—	0	1	—	0	3	—	6	185	3·1
20 to 29 ..	176	713	19·8	4	7	36·4	9	32	21·9	8	25	24·2	197	777	20·2
30 to 39 ..	37	115	24·3	0	5	—	2	25	7·4	1	3	25	40	148	21·3
Over 40 ..	2	8	20·0	0	0	—	0	1	—	0	0	—	2	9	18·1
Total ..	221	1,013	17·9	4	16	20·0	11	59	15·7	9	31	22·5	245	1,119	17·9

TABLE IV
Multiparae Attending Exercise Classes

Age	Normal Vertex Delivery			Spontaneous Face to Pubes Delivery			Forceps Extraction			Breech Delivery			Total		
	With Ex.	No Ex.	Per cent	With Ex.	No Ex.	Per cent	With Ex.	No Ex.	Per cent	With Ex.	No Ex.	Per cent	With Ex.	No Ex.	Per cent
Under 20 ..	0	13	—	0	0	—	0	0	—	0	0	—	0	13	—
20 to 29 ..	17	687	2·4	0	17	—	0	3	—	0	16	—	17	723	2·3
30 to 39 ..	22	442	4·7	1	13	7·1	0	3	—	1	10	9·1	24	468	4·9
Over 40 ..	1	59	1·7	0	0	—	0	2	—	0	4	—	1	65	1·5
Total ..	40	1,201	3·2	1	30	3·2	0	8	—	1	30	3·2	42	1,269	3·2

Classified according to age, the table indicates that exercises were most popular among the 188 aged 30 to 39 (21·3 per cent) and the 974 patients aged 20 to 29 (20·2 per cent); of the 191 primigravidae under 20 years of age only 3·1 per cent attended the classes.

(b) *The Multiparae.* In Table IV it will be seen that of 1,311 multiparae only 42 (3·2 per cent) attended the exercise classes, the same proportion being present whether the pregnancy terminated normally, or whether the foetus was born face to pubes, or breech first. Although the classes were open to the multiparae, the number who availed themselves of the opportunity was

much smaller; in the largest group of 740 multiparae, aged between 20 and 29, only 17 patients (2·3 per cent) attended.

Because of the small number who exercised, it was felt that no conclusions of value could be reached in comparing the labours of the prepared and the unprepared multiparae. The analysis was therefore confined principally to primiparous labours, where more comparable figures are available for study.

Frequency of Attendance

The average number of times patients came to the exercise classes was 5. The frequency of attendance is given in Table V, which shows that 36 patients attended one class, 42 attended two classes, whilst 4 patients attended twelve classes in all. It was disappointing that only 76 (26·5 per cent) were present at seven classes or more, whilst 211 (73·5 per cent) attended six or less.

There was no difference in any of the groups of patients according to age or parity in the pattern of their individual attendances.

Results

The results are portrayed in two groups; firstly, the lengths of the 3 stages of normal labour and the incidence of prolonged labour, and, secondly, the incidence of complications. Each age group is considered separately.

(1) (*a*) The Duration of Labour

(a) *The First Stage of Labour*

The average lengths of the first stage of labour in patients who had spontaneous vertex deliveries are shown in Table VI. It will be seen that 1,013 primigravidae who were not prepared by exercises had an average duration of 16 hours 17·4 minutes, whereas 221 patients who were so prepared had a first stage which lasted for 17 hours 2·0 minutes. When broken down into the age groups the figures show that 183 primigravidae under 20 and 152 between 30 and 39 had a first stage shortened by 2¾ hours and 1½ hours respectively following exercises, 889 between 20 and 29 had a lengthening of approximately 1 hour, and 10 elderly primigravidae showed no practical difference.

If the patients who attended 7 antenatal classes or more are compared, it will be found that 56 primigravidae aged between 20 and 29 averaged 17 hours 33 minutes compared to 16 hours 30 minutes in the unexercised patients of the same age, whilst 12 primigravidae between 30 and 39 had a first stage of 17 hours 50·5 minutes compared to 17 hours 6 minutes.

(b) *The Second Stage of Labour*

The lengths of this stage are also given in Table VI. The overall averages were 1 hour 16·8 minutes with exercises and 1 hour 1·5 minutes without exercises. When the age groups are studied it will be noted that the unexercised patients showed a shorter second stage at every age, namely by 7·4 minutes in the young primigravidae, by 12 minutes in those aged between 20 and 29, by 18 minutes between 30 and 39, and by 1 hour in the elderly patients.

Among those between 20 and 29 who attended more than six classes the average length was 1 hour 0·2 minutes compared to 1 hour 3·4 minutes in the unexercised, and between 30 and 39 it was 1 hour 18·5 minutes compared to 1 hour 8·9 minutes.

(c) *The Third Stage of Labour*

Table VI also shows the durations of this stage, the overall averages being 18·7 minutes after exercises and 18·9 minutes in the unexercised. There was little variation in the age groups, the biggest difference being 3·2 minutes in favour of the exercised elderly primigravidae.

Among the patients between 20 and 29 attending seven classes or more, the average duration was 19·0 minutes compared to 19·6 minutes, and in those between 30 and 39 it was 28·6 minutes compared to 20·4 minutes.

Table V
Frequency of Attendance at Classes

No. of Classes attended ..	1	2	3	4	5	6	7	8	9	10	11	12	
No. of Patients	36	42	30	36	32	35	23	23	16	7	3	4	Total 287

TABLE VI

Showing Average Lengths of Normal Delivery

Age	Under 20		20–29			30–39			Over 40		All Primigravidae	
	With Exercise	No Exercise	With Exercise	7 Classes or More	No Exercise	With Exercise	7 Classes or More	No Exercise	With Exercise	No Exercise	With Exercise	No Exercise
Number of Patients	6	177	176	56	713	37	12	115	2	8	221	1,013
Average length of First Stage	Hrs. Mins. 12 14	Hrs. Mins. 15 0	Hrs. Mins. 17 32	Hrs. Mins. 17 33	Hrs. Mins. 16 30	Hrs. Mins. 15 32	Hrs. Mins. 17 30·5	Hrs. Mins. 17 6	Hrs. Mins. 12 20	Hrs. Mins. 12 36	Hrs. Mins. 17 2·0	Hrs. Mins. 16 17·4
Average length of Second Stage	— 57·0	— 49·6	1 15·2	1 0·2	1 3·4	1 26·9	1 18·5	1 8·9	1 42	— 38·5	1 16·8	1 1·5
Average length of Third Stage	— 15·0	— 15·5	— 18·3	— 19·0	— 19·6	— 22·5	— 28·6	— 20·4	— 12·3	— 15·5	— 18·7	— 18·9
Total	13 26·0	16 5·1	19 5·5	18 32·2	17 53·0	17 21·4	19 37·6	18 35·3	14 14·3	13 30·0	18 37·5	17 37·8

TABLE VII

Showing the Incidence of Prolonged Labour and of Labour Lasting 4 to 24 Hours

	Under 20		20–29			30–39			Over 40		Total	
	With Exercise	No Exercise	With Exercise	7 Classes or More	No Exercise	With Exercise	7 Classes or More	No Exercise	With Exercise	No Exercise	With Exercise	No Exercise
Number of labours exceeding 24 hours in length	0	22	39	17	139	6	3	27	0	1	45	189
Percentage	—	12·5	22·9	30·4	19·6	22·2	25·0	23·2	—	12·5	20·4	18·6
Number of labours exceeding 48 hours in length	0	5	2	2	28	1	0	4	0	0	3	37
Percentage	—	2·8	1·2	3·6	3·9	3·7	—	3·4	—	—	1·4	3·7
Number of Labours lasting between 4 and 24 hours	5	133	128	36	507	30	7	84	2	7	165	731
Percentage	83·3	75·1	72·7	64·3	71·1	81·1	58·3	73·1	100	87·5	74·7	72·2
Average duration	Hrs. Mins. 13 59·0	Hrs. Mins. 12 40·8	Hrs. Mins. 11 56·0	Hrs. Mins. 11 58·2	Hrs. Mins. 12 3·0	Hrs. Mins. 11 16·0	Hrs. Mins. 10 40·7	Hrs. Mins. 11 17·0	Hrs. Mins. 16 30·0	Hrs. Mins. 11 35·0	Hrs. Mins. 11 55·7	Hrs. Mins. 12 4·2

TABLE VIII

Duration of Labour in Primigravidae

Author	Year	First Stage		Second Stage		Third Stage		Total		Babies' Average Weight			
		With Exercise	No Exercise	With Exercise	No Exercise	With Exercise	No Exercise	With Exercise	No Exercise	With Exercise		No Exercise	
		Hrs. Mins.	Hrs. Mins.	Hrs. Mins.	Hrs. Mins.	Hrs. Mins.	Hrs. Mins.	Hrs. Mins. First and Second Stages	Hrs. Mins.	Pounds	Ounces	Pounds	Ounces
Dawson	1941							17 15	17 55	6	12	7	2
Rodway	1947	20 1	19	31	1 21	1 31	0 21	21 44	21 24	7	4½	7	4½
Obstetrical Research Committee, New Zealand ..	1948							17 45	16 20	7	1	7	1
Read	1949	16 15		1 25		0 20		18 0		7	7½		
Thoms and Wyatt	1951	11 59		0 51		0 9		12 59					
Heardman	1951							16 33	22 0				
West Middlesex Hospital ..	1955	17 2	16	17 1	17 1	2 0	19 0	18 38	17 38	7	1	7	5

(d) *The Total Length of Labour*

This shows no constant trend dependent upon exercises. Thus the young primigravidae and those aged between 30 and 39 had a shorter duration of labour (by 2 hours 39·1 minutes and 1 hour 13·9 minutes respectively) after exercises, whereas those aged between 20 and 29 and the elderly had a longer labour by 1 hour 12·5 minutes and 44·3 minutes respectively in the exercised groups.

The patients who attended more than six classes had a longer labour than the corresponding unexercised groups, by 59·2 minutes in those between 20 and 29, and by 1 hour 2·3 minutes between 30 and 39.

There can thus be demonstrated in primigravidae of all ages no significant shortening of any stage of labour as a result of antenatal relaxation and exercises.

(*b*) The Incidence of Prolonged Labour

It may be argued, however, that the arithmetical averages conceal the advantages which antenatal exercises confer on the patient, and this objection can first be met by subtracting from the totals all patients whose labours have been prolonged. This is done in Table VII where it will be seen that after relaxation and exercises 45 primigravidae (20·4 per cent) had deliveries exceeding 24 hours in duration, whilst without exercises 189 patients (18·6 per cent) did so. The proportion of these prolonged labours was practically the same at all ages irrespective of exercises, although the patients who attended classes most frequently had the highest incidences of 17 (30·4 per cent) between 20 and 29, and 3 (25·0 per cent) between 30 and 39.

For deliveries exceeding 48 hours in duration the figures are 3 (1·4 per cent) with exercises and 37 (3·7 per cent) without exercises, there being 2 (3·6 per cent) such cases among the frequent attenders aged between 20 and 29, and none among those between 30 and 39. When broken down into age groups there is no significant difference dependent upon exercises at any age, except labour exceeding 48 hours in patients aged 20 to 29.

If we consider normal labour to last between 4 and 24 hours, and so subtract from the total numbers all patients having a labour of less than 4 hours duration and greater than 24 hours (Table VII), we find that the remaining patients were about the same in the exercised (74·7 per cent) and non-exercised groups (72·2 per cent). The actual durations of labour were also approximately equal in the two groups, being 11 hours 55·7 minutes and 12 hours 4·2 minutes respectively. Amongst those who attended most frequently the figures were slightly smaller, namely 64·3 per cent (20 to 29) and 58·3 per cent (30 to 39), with similar average durations of 11 hours 58·2 minutes and 10 hours 40·7 minutes.

This confirms the work of Roberts *et al.* (1953) who were unable to find any diminution in the incidence of prolonged labour after exercises.

Curves of Labour

So far this analysis has been unable by measurements of lengths of labour and simple averages to detect any effect which antenatal exercises may have upon delivery. There may however be some influence which lurks amongst these figures as yet unrevealed. This may be brought out by graphs showing the scatter of the durations of the stages of labour among the various age groups. In Figures 1, 2 and 3 are shown graphs representing the three stages of normal labour among the 889 primigravidae aged between 20 and 29. The abscissae represent the lengths of each stage whilst the ordinates show the percentage of patients who completed each stage at different times. The patients who have had exercises are shown by a dotted line, and those who have not had them by a continuous line. It will be seen that in each of the three stages of labour the curves practically coincide, thereby showing that relaxation and exercises are without effect upon the frequency distribution of completed labours. In Figure 1 it will be seen that the modal duration of the first stage of labour is about 9½ hours in the exercised patients and 8½ hours in the non-exercised—a considerable difference from the arithmetical means of 17 hours 32 minutes and 16 hours 30 minutes. Up to 17 hours, the number of completed first stages is greater among the non-exercised, at which time the number completed becomes identical in the two groups. Figure 2

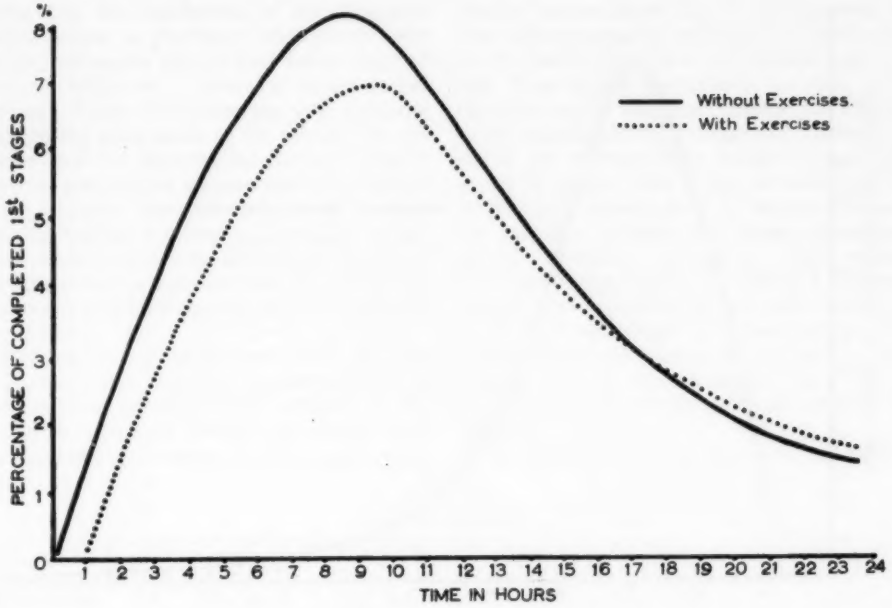

FIG. 1
Graph showing distribution of completed first stages occurring at hourly intervals up to 24 hours in 889 primigravidae aged between 20 and 29.

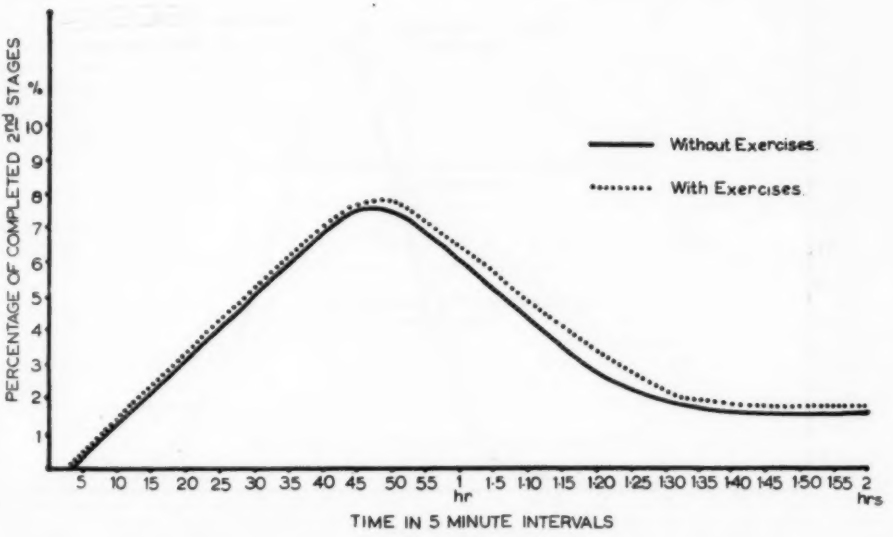

FIG. 2
Graph showing the distribution of completed second stages occurring at 5 minute intervals up to 2 hours.

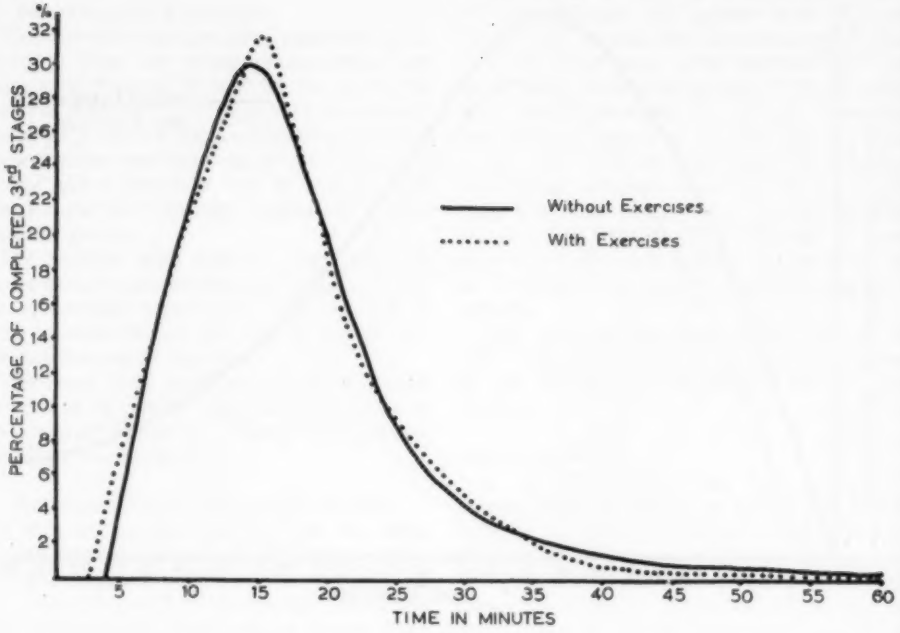

FIG. 3
Graph showing the distribution of completed third stages in 5 minute intervals up to 1 hour.

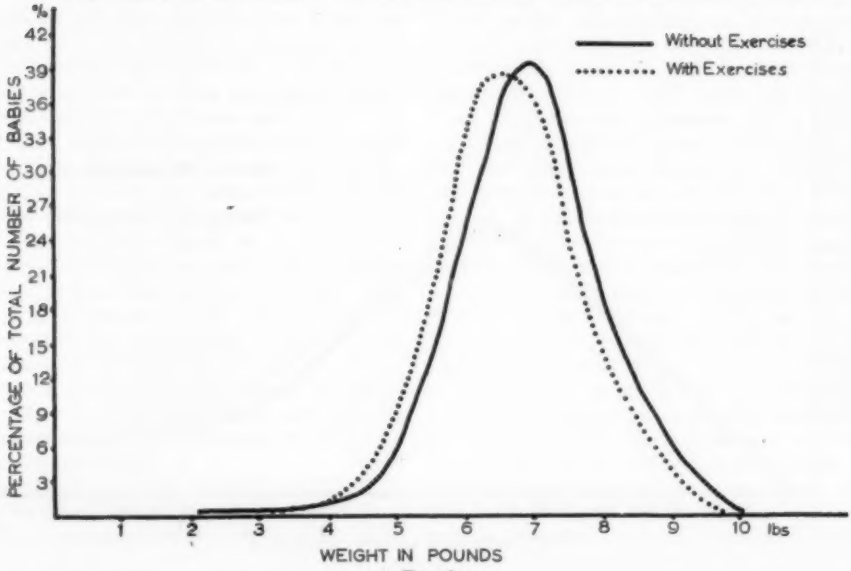

FIG. 4
Showing the distribution of babies' weights.

shows that the distribution of the completed second stages is practically identical in both groups, the modal time in each being about 48 minutes, whilst the arithmetical means exceed the hour. Figure 3 indicates the close similarity between the third stages of the two groups, the modal times for the exercised patients being 15 minutes, and for the non-exercised 14 minutes, which compare with the mean times of 18·3 minutes and 19·6 minutes. A similar coincidence could be shown for patients of other ages, but where the patients are fewer the curves are less pretty, and their reproduction is considered unnecessary.

The labours so far analyzed have all been conducted under the same conditions, and the patients have not statistically differed in any way apart from their presence or absence from the physiotherapy classes. Another factor which should be considered before the similarity of their labours can be established is the weight of the babies born, for if the exercised patients had large babies as quickly as their non-exercised sisters had small babies, the efficacy of the exercises would be suggested. Table IX(a) shows the average baby weight of each age group of patient, and it will be seen that the weights differ by very little. In the total numbers the exercised patients had babies of average weight 7 pounds 1·4 ounces, a little smaller than the average weight of 7 pounds 5·4 ounces among the non-exercised patients. Figure 4 shows that the scatter of babies' weights was approximately the same in the two groups. The similarity of the labours cannot be explained therefore by any disparity in the size of the babies.

The curves showing the distribution of babies'

TABLE IX

(a) *Babies' Weights*

Age group	Under 20		20 to 29		30 to 39		Over 40		Total	
No. of patients	183		889		152		10		1,234	
	pounds	ounces	pounds	ounces	pounds	ounces	pounds	ounces	pounds	ounces
With exercises	6	8	7	2	7	6	7	7	7	1·4
No exercises	7	2½	7	6	7	0	7	4	7	5·4

(b) *The Incidence of Toxaemia*
(Percentages)

With exercises	0	13·6	27·0	50·0	15·8
No exercises	15·3	12·2	16·7	0	13·1

(c) *The Incidence of Lacerations and Episiotomies*
(Percentages)

With exercises	60·0	67·6	71·9	66·7	67·9
No exercises	27·7	68·4	71·4	100·0	62·0

(d) *The Incidence of Premature Labour*
(Percentages)

With exercises	20·0	4·8	0	0	4·7
No exercises	7·9	3·6	8·6	20·0	5·2

(e) *Stillbirth and Neonatal Mortality/1,000 Births*

With exercises	0	22·7	0	0	18·1
No exercises	16·9	11·2	34·8	0	14·8

weights are typical Gaussian or bell-shaped curves, as indeed is to be expected. It is perhaps more remarkable that the curves of the length of labour bear a close resemblance to this type of curve, being in fact skewed Gaussian curves not asymptotic at one end. It is clear from the curves that the mode is a much more valuable indication of the average length of labour than is the arithmetical mean. It will be of interest to integrate the Gaussian curves of labour, to obtain summation curves. These are reproduced in Figures 5, 6 and 7 for the three stages of labour. In these curves the total number of completed stages is plotted against the passage of time. It will be seen that the curves are typical logistic curves each with an inflection about half-way between its asymptotes. They are thus Verhulst-Pearl curves and not of the skewed Gompertz type. It is interesting to see that the rate of completion of the stages of labour conforms to the fundamental curve of growth which applies in general to growing matter. The obstetrical event of labour thus obeys the same mathematical laws as does the rate of growth of a colony of bacteria, plants, insects, animals and indeed man himself. Not only does the intra-uterine growth of the individual show a similar pattern but also the spread of an epidemic disease and the growth of the population of a country follow the same curve with the passage of time. This type of curve is also shown by the energy stored in a condenser (plotted against time) which is charged through resistance from a constant voltage source. Obstetrics therefore can take its place alongside other natural phenomena in that labour obeys universal mathematical laws applicable to the growth process.

Apart from the intrinsic interest of these graphs, it will be seen that in each stage of labour the summation curve is practically identical whether plotted from patients who practised antenatal relaxation and exercises or from those who did not do so.

Comparison of Results

It might be convenient at this point to compare these results with those of other workers,

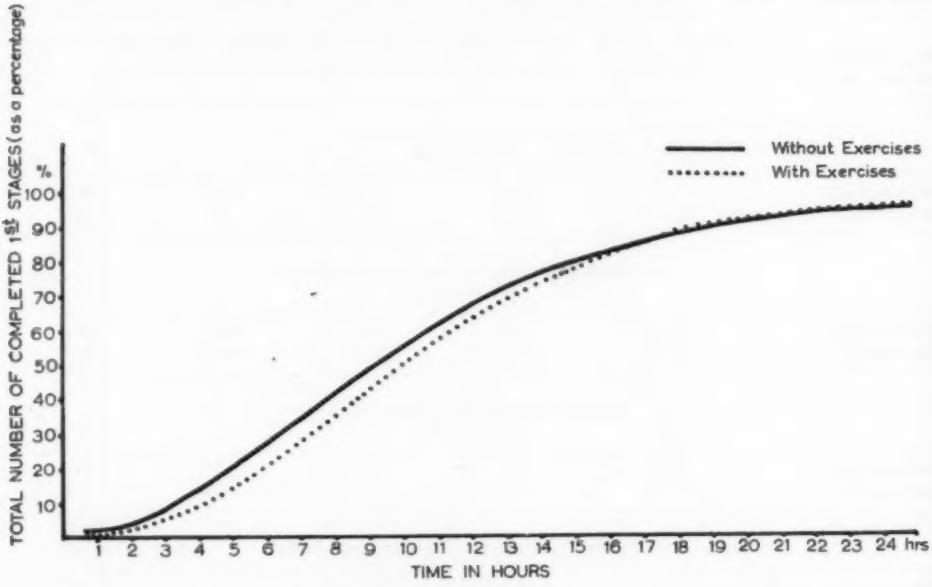

FIG. 5
Curve showing the total number of completed first stages with increasing time in hours.

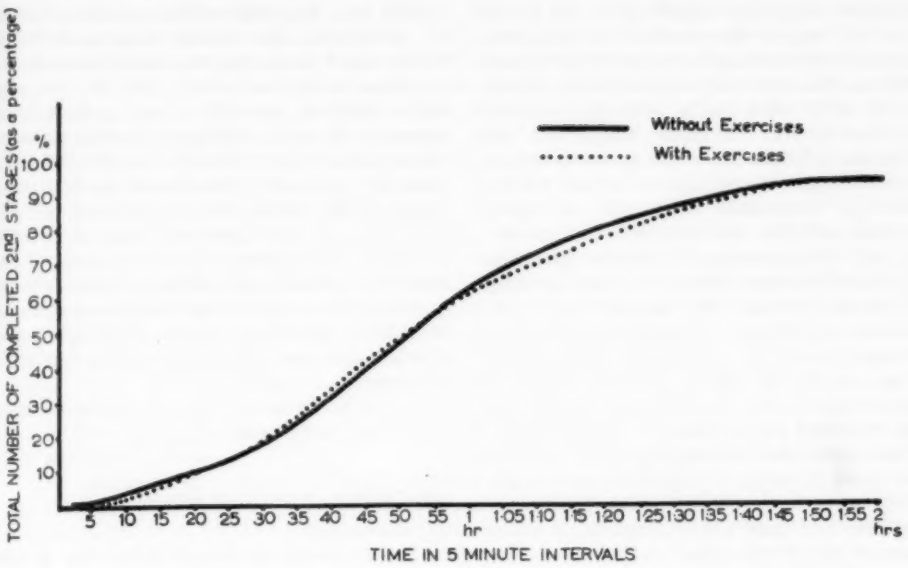

FIG. 6
Curve showing the completed number of second stages with increasing time.

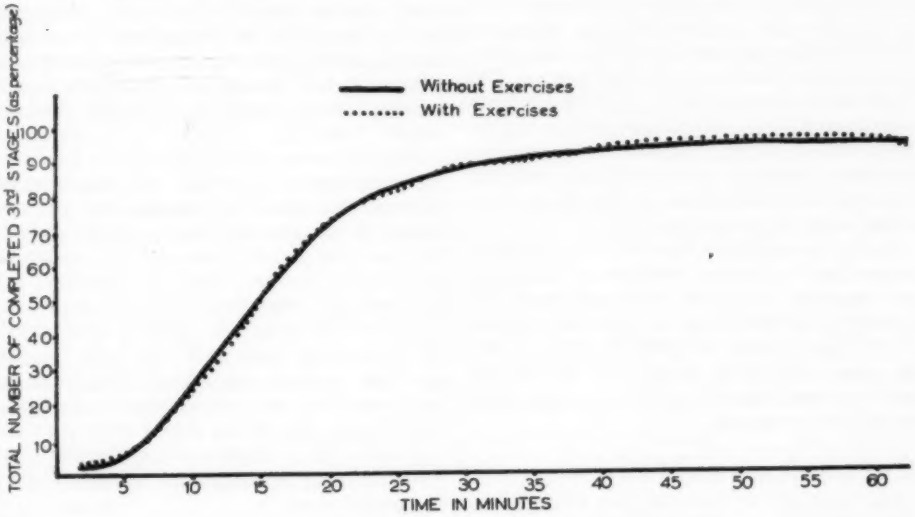

FIG. 7
Curve showing the total number of completed third stages with increasing time in minutes.

which are shown in Table VIII. It will be seen that each author who makes the comparison finds that the first stage is longer in the exercised patients, the second stage is variable but approximately of the same length, whilst the third stage is identical (two observers only). The total duration of labour in the two groups is approximately equal according to three authors, although Heardman, with 800 primigravid patients and 800 controls, finds that exercises produce a shortening of 5½ hours. Thoms and Wyatt (1951) have reduced the average length of labour in their 292 exercised primigravid patients to less than 13 hours, but they give no comparable time in unexercised patients. In all cases quoted the babies' average weights are about equal in the two groups. It is clear from the preceding section that the average length of labour is an unsatisfactory figure for estimating the modal duration, and furthermore, as there is some variation in deciding when labour starts and the first stage ends, comparisons between authors are of little value.

Correlation Between Length of Labour and Frequency of Attendance

It might be argued that patients who came to antenatal classes on six or fewer occasions would be less attracted by physiotherapy techniques and would therefore practise them less than those attending the classes seven times or more. The lengths of the stages of labour and the incidence of prolonged labour have therefore been quoted above for those primigravidae who attended more than six classes, and it has been noted that this increased preparation produced no consistent improvement in the figures.

It may be concluded therefore that antenatal preparation for labour, consisting of relaxation and exercises, exerts no influence upon the duration of normal labour or upon the incidence of prolonged labour in primigravidae of any age group, and this is equally true whether the patients attend classes frequently or occasionally during their pregnancy.

(2) (*a*) Complications of Pregnancy

The incidence of pre-eclamptic toxaemia in each group has been calculated, the criteria adopted being a blood pressure raised above 130/80 mm. Hg with oedema, or the presence of albuminuria. The results are given in Table IX(b), which shows that the overall incidence of toxaemia in the two groups was 15·8 per cent with exercises and 13·1 per cent without exercises. In the 68 primigravidae who attended more than six classes of preparation the incidence was 19·1 per cent. These figures contrast with those of Heardman, who found rates of 5·6 per cent and 10·5 per cent respectively, the variation in incidence being explained by the fact that Heardman's figures relate only to patients who complained of toxaemic symptoms. The West Middlesex figures, although worse for the exercised patients, show no significant difference.

It will be observed that toxaemia occurred more frequently with increasing age.

(*b*) Complications of Labour

(a) *Lacerations*

The incidence of lacerations of the genital tract, including episiotomies, is shown in Table IX(c), where it will be seen that there was no significant difference between the exercised and non-exercised groups. The rather high rates of 67·9 per cent and 62·0 per cent are explained by the fact that the Department is a large training school both for medical students and pupil midwives. Among the primigravidae who attended seven classes or more the incidence was 67·7 per cent.

Other observers have compared the frequency of lacerations in exercised and non-exercised patients, Dawson (1941) quoting 65·3 per cent and 61·0 per cent respectively, Rodway (1947) 60·0 per cent and 56·2 per cent, the Obstetrical Research Committee (1948) 56·0 per cent and 60·0 per cent, Heardman (1951) 47·5 per cent and 63·4 per cent, and Roberts *et al.* (1953) 62·3 per cent and 55·0 per cent. Among exercised patients only, Read (1949) had an incidence of 48 per cent in physiological cases and Thoms and Wyatt (1951) 86·9 per cent. It is quite clear, therefore, that exercises have no effect upon the occurrence of lacerations of the genital tract.

The higher incidence with increasing age will again be noticed.

(b) *Post-partum Haemorrhage*

Post-partum haemorrhage exceeding 10 ounces was estimated in all cases of spontaneous vaginal delivery, and the incidence in the exercised group was found to be 12·1 per cent, and in the non-exercised group 11·4 per cent. Rodway found rates of 8·3 per cent and 12·8 per cent respectively (loss exceeding 20 ounces), whilst Heardman quotes 1·1 per cent and 3·1 per cent, and Roberts *et al.* 2·3 per cent and 4·0 per cent in corresponding groups (amount of blood loss is not stated). Read found an incidence of 14·2 per cent (10 ounces or more) in his primigravid patients. The West Middlesex figures do not suggest that exercises have any effect upon the occurrence of post-partum haemorrhage.

(c) *Premature Labour*

The incidence of premature labour, shown by the birth of a baby weighing 5½ pounds or less, is indicated in Table IX(d). It will be seen that the exercised patients had 4·7 per cent of premature births whilst those without exercises had 5·2 per cent. Corresponding figures obtained by other workers are Dawson 9·0 per cent and 7·0 per cent respectively, Rodway 5·3 per cent and 4·1 per cent, and the Research Committee, New Zealand, 7·4 per cent and 13·0 per cent. There is thus no consistent trend in the figures and no beneficial effect of exercises in the prevention of premature births is to be inferred.

(d) *Spontaneous Delivery Face to Pubes*

The total number of babies born spontaneously face to pubes amounted to 51 out of a total of 2,604 vertex deliveries. These are analyzed in Table X which shows that the incidence of this complication was 1·7 per cent in the 236 primigravidae who had exercises, and 1·5 per cent in the 1,088 who did not; no babies were born face to pubes amongst the 68 primigravidae who attended more than six classes of preparation. In the 1,280 multiparae the rate was 2·4 per cent in both the exercised and unexercised groups. Heardman also compared these incidences, and found them to be 3·3 per cent and 2·5 per cent respectively. It is apparent that antenatal exercises exert no influence upon the occurrence of this abnormality.

(e) *Forceps Extraction*

An analysis of babies born with the aid of forceps is also shown in Table X. Amongst the primigravidae the forceps rate was 4·7 per cent in 236 patients with exercises, and 5·4 per cent in 1,088 without exercises; amongst the 68 who attended seven or more classes of preparation the rate was 4·4 per cent. In the multiparae forceps were not employed for 41 exercised patients, and were required for 0·6 per cent of 1,239 who had no exercises.

Many other observers quote their forceps rates in primigravidae and these may be briefly stated. Thus Dawson found it to be 18 per cent with exercises and 17·3 per cent without exercises, Rodway 12·1 per cent and 11·4 per cent, Roberts *et al.* 7·6 per cent and 6·9 per cent, the New Zealand Research Committee 14·2 per cent and 20·0 per cent, and Heardman 7·8 per cent and 15·9 per cent. Although the forceps rates of different authorities vary con-

TABLE X

Incidence of Spontaneous Delivery Face to Pubes and by Forceps

Parity	Primigravidae	Multiparae	Total
Total number of vertex deliveries ..	1,324	1,280	2,604
With exercises	236	41	277
Face to pubes	4=1·7 per cent	1=2·4 per cent	5=1·8 per cent
Forceps extraction	11=4·7 per cent	0=0 per cent	11=4·0 per cent
No exercises	1,088	1,239	2,327
Face to pubes	16=1·5 per cent	30=2·4 per cent	46=2·0 per cent
Forceps extraction	59=5·4 per cent	8=0·6 per cent	67=2·9 per cent

siderably, showing that extractions are performed for different indications, the majority of observers find the same rates amongst the two groups of their own patients. Read, and Thoms and Wyatt report a forceps rate of 16·0 per cent in primigravidae, which is certainly rather high. It may be concluded that the adoption of antenatal exercises does not diminish the forceps rate.

(f) *Breech Delivery*

Amongst the primigravidae there were 40 breech deliveries, an incidence of 2·9 per cent. Only 9 of these patients attended antenatal exercise classes, and Table XI shows that they had a slightly shorter labour, lasting 16 hours 47 minutes compared to 17 hours 16 minutes in the 31 unexercised patients. Rodway reports that the average times for breech delivery in her patients were 14 hours 55 minutes and 19 hours 14 minutes respectively.

Incidentally it will be noticed on comparison with Table VI that the length of labour was not significantly different from the length of labour when the vertex presented. Among the exercised patients 75·0 per cent had labours lasting between 4 and 24 hours, compared to 76·9 per cent of the unexercised group; these figures compare with 74·7 per cent and 72·2 per cent respectively of the vertex deliveries which lasted between these times.

(g) *Stillbirth and Neonatal Mortality*

The stillbirth and neonatal mortality amongst the primigravidae who had normal labours is shown in Table IX(e). It will be seen that the combined rates per 1,000 total births were 18·1 with exercises and 14·8 without exercises. Dawson reports corresponding figures of 33 and 19, and the Research Committee 32 and 17. The actual stillbirth rates were 16·6 and 9·5 respectively, which compare with rates of 24·8 and 21·5 reported by Rodway, 6 and 10 by Heardman, and 8 and 11 by Roberts *et al.*

Discussion

This analysis of 2,675 patients shows that, despite much painstaking and persevering work on the part of doctors, midwives, and physiotherapists, antenatal relaxation and exercises have no influence on the length and character of labour. Not only do the duration of labour and the incidence of complications differ but little in the exercised and unexercised groups of patients, but the differences show no consistent trend, sometimes being in favour of exercises and sometimes against them. The patients themselves are not very enthusiastic in attending classes; in spite of persuasion they appeal to only 20 per cent of primigravidae and 3 per cent of multiparae. This fact in itself is revealing, for it shows that multiparae think the classes unnecessary. Once they have experienced labour, they feel there is no need for them to attend for antenatal preparation, and even when they have had a difficult first delivery, they do not come to try to improve their second one. This may be partly explained by their increased domestic responsibilities and small children who cannot be left at home, but this need not be so as they are permitted to bring their children to the classes, and the almoners would make alternative arrangements if the patients were keen.

The investigation here described is in no sense a controlled experiment, because the patients given physical training were all volunteers, and this immediately vitiates the results from the point of view of a mathematical analysis and renders tests of statistical significance misleading.

Table XI
A Comparison of Breech Deliveries

	No.	Duration of Labour								Between 4 and 24 hours			Babies' Average Weight	
		1st Stage		2nd Stage		3rd Stage		Total		Percentage	Average Lengths			
		hours	mins.	hours	mins.	hours	mins.	hours	mins.		hours	mins.	pounds	ounces
With exercises	9	15	37	0	59	0	11	16	47	75·0	9	50	7	0
No exercises ..	31	15	44	1	18	0	14	17	16	76·9	11	58	6	9

It is sufficient however to suggest that the exercises, as carried out by the best techniques in a modern hospital, will not affect the length or the character of the subsequent labour. It might be argued that the patients, being volunteers, are the type who consider labour more of an ordeal than the majority who show no interest. This may mean that if the exercised group had not attended the classes their labours would, on the average, have lasted for a longer time and have produced more complications, and the effect of exercises has been to convert their difficult labours into normal ones. This conception rather suggests an argumentative *tour de force*, and although a possible explanation of the results is unlikely to be the true one.

Whilst this physical preparation does not affect the length and character of labour, it is possible that it favourably influences the amount of pain suffered by the parturient patient. This, however, for reasons already stated, has not yet been proved, and it must remain a personal impression whether this is indeed so. Certainly some patients have relatively painless labours whilst others suffer unduly; this however has no proved relationship to previous physical preparation and depends essentially upon the patient's own mental make-up. Relaxation is not a *via sacra* to pain relief, and no one has suggested that victims of spasmodic dysmenorrhoea suffer less if they relax while their pains are present. In this connexion it must be remembered that the assertion that "primitive" women and animals have painless uncomplicated labours is quite untrue.

On reading enthusiastic letters to the lay and medical press, one feels that relaxation and exercises have benefited the few to such a degree that every endeavour should be made to extend their advantages to the many. Yet when this is done, as in the present series, the results are disappointing. On the other hand patients are well known to have equally quiet controlled labours without any antenatal preparation whatsoever; quite often single girls and young patients in their early teens behave in this way. It is fashionable to assume that, when a patient who has relaxed and exercised during pregnancy has a quick and easy labour, the one is necessarily due to the other. This is probably a wrong assumption, for this series shows conclusively that it is not so as regards the length and character of labour, and it still remains to be proved that more "ideal" labours follow exercises than occur among non-exercised patients.

Although they have no effect on the character of labour, it may be conceded that antenatal exercises are beneficial in other ways. It is generally agreed that postnatal exercises are performed more efficiently by the patient who has exercised during pregnancy, and it is often maintained by midwives that the mother who has practised relaxation is better able to breast-feed her baby and to cope with her household duties when she returns home. As many of these benefits result from psychological causes, it is possible that it is psychotherapy which is of real value, and when an "ideal" labour follows exercises it is in truth the result of psychological preparation mediated through the exercises. Before, however, we direct our energies to more and better psychotherapy, we should remember that many patients prepared in this way, including midwives and lady doctors themselves, often have long and complicated labours; we cannot expect to prepare ordinary patients as much as these professional women are prepared, and if psychotherapy has failed with them there is not much hope of its helping the laywoman.

Psychiatrists who have investigated the problem hold out but slight encouragement. Cramond (1954), after an admirable survey into the psychological aspects of uterine dysfunction in a controlled series of patients, found that those who had a prolonged labour showed less overt anxiety in the presence of an unfamiliar situation, that they complained less often of tremor and sweating as expressions of anxiety, and that they had a greater bias towards rigidly conventional and socially desirable standards of conduct than did patients who had normal labours. As this "dysfunction temperament" could not be altered by treatment during pregnancy, he concluded that there is little or no scope for psychotherapy during pregnancy as a means of preventing uterine dysfunction, and that fear, emotion, and anxiety play no part in the outcome of labour from the practical obstetrical point of view.

It thus seems that little benefit will come from a purely physical preparation for labour or from a purely psychological one. Are there any other ways in which we can help our patients to have easy labours? Consideration of such labours when they occur shows that the patients co-operate better if they are never left alone at this time, and if they have with them an attendant whom they both know and like. Any improvement that will come is likely to materialize from a closer association between the patient and her attendant—if liking and affection can be engendered during pregnancy, if the attendant forewarns the patient of her ordeal and teaches her the facts of labour, and, above all, if she is with her during labour, reassuring and encouraging her all the time, then the best results will be obtained. Relaxation is not easy to achieve, particularly when the patient is frightened and hurt, and in the stress of labour she forgets, or is unable to carry out, the things she has learnt. But if her teacher is there with her, able to console her and reiterate her lessons, better results are more likely to follow. If antenatal exercises are a means of establishing this co-operation, then let them be continued, but if it can be obtained more simply and cheaply in some other way, then let them be discarded.

The probable future of antenatal preparation for labour, therefore, lies in the forging of a relationship between the patient and her attendant, rather than in holding large classes for the practice of relaxation and exercises. Education and reassurance should be given antenatally, but the instruction should be personal, and the teacher should be present during labour to encourage her patient and to enforce her teaching. It is important to look upon delivery as a specific achievement of the patient and her attendant, rather than a mass production by a staff of supervisors lecturing to classes of expectant mothers. This after all is one reason why domiciliary midwifery is still so popular in this country. What is wanted is a synthesis between the best features of hospital practice, represented by educational talks and demonstrations, and the best features of domiciliary practice, represented by the intimate association of patient and attendant. The presence of the physiotherapist in the labour ward does not serve the same function, as no close rapport exists between her and the individual member of her classes.

Hospital midwives should therefore be allocated individual patients whose expected dates of delivery follow at fixed intervals. They should then teach them during pregnancy as part of their routine antenatal care, thereby creating an atmosphere of partnership, and this should be followed up by their personal attendance at the delivery. Such a practice would probably be quite uneconomic in hospital, but large exercise classes have been shown to be disappointing in their results, and they should therefore be abandoned, and, if it is hoped to improve the experience of labour, some such alternative system should be developed in their place. An "ideal" labour is most likely to occur only after an "ideal" attendant has the time to teach her "ideal" patient throughout the waiting weeks of pregnancy, and to supervise her during the climax of labour itself.

Summary

(1) The literature relating to the physical preparation for labour is reviewed.

(2) The technique of antenatal relaxation and exercises as employed at the West Middlesex Hospital is briefly described.

(3) The lengths of the three stages of labour, and the incidence of prolonged labour, in prepared and unprepared primigravidae, are presented and compared.

(4) Gaussian and Verhulst-Pearl curves of normal labour are constructed.

(5) The incidences of complications of pregnancy and labour in exercised and non-exercised patients are compared.

(6) It is suggested that large antenatal classes of physical instruction be abandoned and replaced by individual tuition and instruction of the patient by her attendant.

Acknowledgments

I would like to record my thanks to Miss P. M. Hall, S.R.N., S.C.M., M.C.S.P., for giving me her skilled opinions on the techniques of antenatal physiotherapy, to Miss S. M. Robinson, M.M.A.A., for drawing the graphs,

and to Mr. and Mrs. A. Mazzucato for their help in collecting the statistics.

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BRENNER TUMOURS OF THE OVARY

A Report of Nine Cases Including One with Malignant Degeneration

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INTRODUCTION

ALTHOUGH the first case of Brenner tumour was described in London there have been remarkably few papers on the subject published in Britain. The object in publishing the present series of 9 cases is to draw attention to the histological peculiarities of the tumour and to discuss especially two of its generally accepted characteristics, namely that it is a simple tumour and that it has no hormonal effect. It has become obvious that many of the tumours described in the literature and in historical reviews as Brenner tumours were of another nature, and that recently papers have been published in which the histological interpretation requires critical appraisal. It has therefore been thought necessary to give a fairly full historical review of the segregation of the tumour into its own special group, and of the theories of histogenesis and the reasons for them, as only by so doing can the difficulties of the earlier pathologists be appreciated and errors which have been perpetuated in the literature be rectified.

HISTORY

Towards the end of the nineteenth century a number of ovarian tumours were described which did not fit into any existing classification. The striking feature of these tumours was the appearance of epithelial elements resembling the epithelium of Graafian follicles, and of cells which resembled primitive ova, in tumours which from their macroscopic appearance had been considered to be fibromas or primary carcinomas.

Among the first to report such tumours were Acconci (1890) who observed structures identical to primitive ova in the wall of what was probably a serous cystadenocarcinoma, and Emanuel (1893) who described 2 similar cases. Von Mengershausen (1894) described a tumour which contained round masses of epithelial cells which had the character of primordial follicles and called it "adenocarcinoma folliculare ovarii". Von Kahlden (1895) reported an "adenoma folliculi Graafiani" which was half solid of the granulosa type and half cystic resembling a papilliferous cyst. Gottschalk (1899) coined the name "folliculoma malignum ovarii" for a tumour which from the illustrations may have been a secondary carcinoma or a de-differentiated papillary serous adenocarcinoma. Amann (1899) also found groups of cells like the follicular cells of the newborn in an otherwise normal senile ovary.

Schroeder (1901) appears to have been the first to try to classify these tumours. He described the occurrence of follicular deposits in an ovarian tumour which would now be called a granulosa cell tumour, grouped this tumour with some of the others which have been described and suggested the name used by Gottschalk (1899) "folliculoma".

All manner of tumours which contained epithelial elements soon came to be included in the folliculoma group and what would now be known as granulosa cell tumours, luteomas, Brenner tumours and primary and secondary carcinomas were classified together. Voigt (1903) described what may well have been a luteoma and Blau (1907) described a typical granulosa cell tumour. Ingier (1907) published a report of 2 tumours which she included in the group "folliculoma ovarii" one of which was surely a primary or secondary carcinoma and the other a typical granulosa cell tumour.

The main reason why these tumours were

grouped together was that most of them contained "egg-like structures". It has been pointed out in the literature again and again that these cells have no connexion with true ova. Liepmann (1904) concluded that the cells were the product of a "retrogressive metamorphosis", McIlroy (1906) did likewise and as late as 1926 Blau concluded again that they were merely products of "retrogressive metamorphosis" in a carcinoma. In spite of this, the occurrence of egg-like cells continued to be thought of importance, and it was thus that Brenner tumours, which often contain such cells, took so long to be recognized as a separate entity.

The first undoubted case of Brenner tumour was that described by Macnaughton-Jones who showed the tumour at the Obstetrical Society of London on the 6th April, 1898. The illustration accompanying his description shows the true nature of the growth. It may be that he was preceded by Doran (1884) of London who reported a very large tumour which contained "many oval and round cavities. The characters of the epithelium bore no relation to the original elements in the ovary." There is however no illustration and the description is inconclusive. Orthmann (1899) published a report of 6 unusual tumours, the last of which he called "fibroma papillare superficiale carcinomatosum". This is a typical Brenner tumour. Fothergill (1902) reported 2 tumours which were Brenner tumours and remarked on the occurrence of egg-like cells. He showed sections of the tumours to Schroeder who diagnosed "fibroadenocarcinoma from the membrana granulosa of primordial follicles", and to Orthmann who recognized the resemblance to the tumour he had already described. Fothergill himself placed the tumours in the folliculoma group. Another similar tumour was recorded by Hellier and Smith (1902).

Brenner (1907) was the first to attempt to form a special group for the tumour which has come to be called by his name. He described 3 tumours 2 of which were obtained at post-mortem. He took exception to the word folliculoma, ". . . an unhappy combination of a Latin word with a Greek ending", and suggested that the group of tumours be called "oöphoroma" with the addition of "folliculare" for the type of tumour he described. The tumours were known by this name for many years but the name itself with the stressing of the egg-like cells did much to confuse subsequent classification.

Glockner (1905) reported a number of solid tumours one of which (No. 33) was thought by Meyer to be a Brenner tumour but the illustrations do not show a typical growth. Darwall Smith (1909) showed a typical tumour at the Royal Society of Medicine, and Spencer (1926) described as adenofibromas 2 tumours of a similar nature. Von Werdt (1914) described 6 tumours which contained epithelial elements. The third was a typical Brenner tumour and the fourth he said was very similar. He designated all 6 tumours, which included one true and 2 probable granulosa cell tumours and one probable dysgerminoma, "granulosazelltumoren" and suggested that the Brenner tumours were the most differentiated of the group. It is interesting to note that Teoh (1953) gave a similar opinion and considered that the Brenner tumour was a member of the granulosa-theca cell series.

Aschner (1922) reviewed the literature and reported a case of a malignant ovarian cyst which resembled corpus luteum. This tumour produced menstrual upset and was probably a granulosa cell tumour. He collected 24 previous cases including the 3 reported by Brenner and grouped them together as folliculomas. Blau (1926) in a critical article on "Folliculoma Ovarii" appealed for a much sharper definition of folliculoma and discarded the term oöphoroma as being redundant. He excluded the cases reported by von Kahlden (1895), Voigt (1903), McIlroy (1906), Ingier (1907) and himself (1907) from the group and came to the conclusion that only 11 true folliculomas had been described to date (1926). In this 11 he included the 3 tumours of Brenner, 3 of von Werdt (1914), 1 of Seifried (1923) a Brenner tumour, 2 of Krompecher (1924) 1 a Brenner tumour and 1 probably a carcinoma, and 2 which he described in the article and were granulosa cell tumours. Confusion was worse confounded.

It was Meyer (1932) in his classic article who pointed out the differences between Brenner

tumours and granulosa cell tumours and who, being recognized as an authority, gave the guide for future classification. Meyer showed that the difference between the tumours was so great that once one had seen a few Brenner tumours they could be recognized at once. He sifted the literature and collected 16 cases of Brenner tumour, in 8 of which he was able to examine the original sections. He added 5 of his own. He did not, however, include in his review the true Brenner tumours of Macnaughton-Jones (1898), Fothergill (1902), Hellier and Smith (1902), and Fleming (1929). He divided Brenner tumours into 2 groups, those which occur as solid tumours and those which arise in the wall of cysts. He pointed out the association of Brenner tumours and pseudomucinous cysts and how the Brenner epithelium could assume a pseudomucinous character particularly in the lining of the spaces in the epithelial nests. He discussed the staining reactions of Brenner cells and of granulosa cells and insisted on the simple nature of the Brenner tumour. After the publication of this article the study of Brenner tumours became comparatively easy.

The next year Plaut (1933) reported 8 cases and in 1938 Varangot was able to collect 109 cases in the literature. Since then several large series have been published especially in America. Fox (1942) published 4 cases and a good review of the literature, Jondahl, Dockerty and Randall (1950) reported 31 cases occurring in the Mayo Clinic and Reagan (1950) had 23 specimens available for study.

Present Series

The present series consists of 9 tumours which were removed at operation in the Royal Samaritan Hospital, Glasgow. The 3 cases already reported by Fleming (1929) from this hospital are not included. In 7 cases the patient was operated on for ovarian disease and in 2 cases the Brenner tumour was found as a result of routine pathological examination. The main clinical features are summarized in Table I.

Incidence

The 9 tumours were found in the 24-year period ending in 1954. The hospital is devoted solely to the treatment of gynaecological conditions and during the 24 years over 75,000 patients were admitted and 1,491 ovarian neoplasms were removed; 1,088 of these tumours were cystic and 403 were solid, 9 were Brenner tumours. Thus in this series Brenner tumours formed about 0·6 per cent of all ovarian neoplasms and about 2 per cent of all solid tumours.

Comparable statistics are not easily available. Thirty-one patients were found to have Brenner tumours in the Mayo Clinic in 36 years (Jondhal *et al.*, 1950). Von Szathmary (1933) found 5 cases in 1,114 ovarian tumours in 15 years, an incidence of 1·45 per cent and Novak (1947)

Table I
Clinical Features

Case No.	Age	Parity	Married	Side	Size	Associated Pseudo-mucinous Cyst	Malignancy Present	Symptoms
1	51	7	Yes	Right	23 cm.	Yes	No	Pain.
2	62	1	No	Right	15 cm.	Yes	No	Vaginal bleeding for 3 months.
3	52	0	No	Right	15 cm.	Yes	No	Pain.
4	48	0	No	Right	Solid Portion 7·5 cm.	Yes	No	Abdominal swelling.
5	42	0	No	Right	18 cm.	Yes	No	Abdominal swelling.
6	54	2	Yes	Right	8 cm.	No	No	Vaginal bleeding 6 days.
7	52	0	Yes	Left	2 cm.	No	Adenocarcinoma of uterus	Vaginal bleeding.
8	54	2	Yes	Left	1·3 cm.	No	No	Menorrhagia.
9	64	0	Yes	Left	15 cm.	Yes	Yes	Pain.

observed 19 cases in over 48,000 case specimens. Few authors report more than 4 or 5 cases of their own. It may therefore be considered a rare tumour.

Age

The average age in this series was 53. The oldest patient was 64 and the youngest 42. This bears out Meyer's statement (1932) that over 50 per cent of the patients are over 50 years of age. This was also confirmed by von Szathmary (1933), Varangot (1938), Novak (1947) and Fox (1942). It is noteworthy that in many of the collected series a number of the specimens were obtained at post-mortem; this might tend to increase the average age.

The average age was compared with the ages of women suffering from other types of ovarian tumour. In a series of 27 fibromas from this hospital the average age was 51, in 19 granulosa cell tumours it was 53, in 108 pseudomucinous cysts it was 44, while in 56 carcinomas of the ovary it was 50 years. The average age of patients on the discovery of Brenner tumours does not then materially differ from that of other solid tumours.

Pathology

Gross Appearance

For descriptive purposes Brenner tumours may be divided into 3 types. The commonest in this series is the type which appears as a solid growth in the wall of a pseudomucinous cyst. Such a tumour is seen in Figure 1 (Case 3). This shows the whorled appearance of the cut surface indistinguishable to the naked eye from a fibroma. The second type is the solid tumour large enough to be felt on bimanual examination (Fig. 2, Case 6). The third type is that which is found on pathological examination and is so small that the operator may not be aware of its existence (Fig. 3, Case 7). There is no feature of the macroscopical appearance that would lead one to diagnose Brenner tumour without a histological examination.

Histology

The morphology of the cells which make up the epithelial cords is by no means constant. This is best illustrated by reference to the actual specimens.

In Case 1 the columns are made up of cells in which the cytoplasm is large and mucoid and takes up little stain. The cytoplasm contains vacuoles which are filled with secretion. The cell margins are well defined and form a network where the cell abuts on its neighbours. The nuclei are rather small and take stain lightly. They are often spherical or nearly so but ovoid nuclei are common (Fig. 4). In this case the arrangement of the cells in the column is characteristic. There occur:

(*a*) Solid cords of epithelial cells.

(*b*) Cords with circular spaces, the space being lined by an endothelial type of cell. This lining may be very fine but is quite distinct from the surrounding epithelial cells (Fig. 4).

(*c*) Spaces round which there is only the endothelial lining.

(*d*) Cords in which the spaces are lined by cells which tend to become columnar. This differentiation may be so marked that the lining cells are almost pseudomucinous in type (Fig. 5).

(*e*) Spaces surrounded only by pseudomucinous epithelium. There are thus present in this tumour all gradations from solid cord of "Brenner" cells to typical pseudomucinous epithelium. This type of epithelium is similar to that of the cases shown by Macnaughton-Jones (1898), Orthmann (1899) and Fothergill (1902).

Case 2 illustrates a different type of cell. The epithelial cords vary in character; in the denser parts of the tumour the nuclei are oval or spindle-shaped and are closely packed together. They stain deeply and many show a longitudinal groove. The cytoplasm is minimal and the cell margins are poorly defined (Fig. 6). In the area near the pseudomucinous cyst the stroma is less dense and the columns stain less heavily and become very like those described in Case 1 (Fig. 7).

Cases 4 and 6 show a well defined pattern in the epithelial columns. The epithelial cells have long oval nuclei with a longitudinal groove. These cells tend to be arranged radially from the centre and lie at right angles to the stroma at the periphery. The cells around the central space are

usually arranged circularly round it (Figs. 8, 9 and 10).

The longitudinal groove seen in many of these cells has aroused some interest. It was commented on first by Varangot (1938), who noticed that there was often a long "batonnet" in the long axis of the nucleus dividing it into 2 parts. He thought that this might be a sign of amitotic division of the cells. Arey (1943) investigated this subject and found that the appearance was due to the folding or grooving of the nucleus producing plates where the two surfaces met. These grooves can be clearly seen in Fig. 2 of Brenner's original article (1907) and in Meyer's Fig. 8 (1932). The significance is doubtful and is more fully discussed under histogenesis.

These cases show that Brenner epithelium may consist of cells varying in type from the closely packed cells with little cytoplasm and large deeply staining nuclei which predominated in 4 of the present series, to the large mucoid cells which predominated in 3 of the cases. Both types of cell were seen in 2 of the cases. They also show the gradual transition from the mucoid cells to pseudomucinous cells.

Case 9 requires a more detailed description. This tumour was removed from an emaciated woman who died 6 months after the operation. The abdomen contained ascitic fluid and the tumour replacing the right ovary was 15 cm. in diameter. The left ovary and the uterus appeared normal. The tumour was partly cystic and partly solid. Some of the solid portion was hard and the rest was soft and spongy. The loculi of the cystic portion were very small and were crowded together to form a semi-solid mass. Microscopically the epithelial elements showed the variations described in the previous cases. The radial arrangement of the oval nuclei with longitudinal grooves was seen (Fig. 11) and the pale secretory cells with rounded nuclei were present (Figs. 12 and 13). Some areas showed a typical but somewhat degenerated pseudomucinous cystadenoma. The striking difference between this tumour and the others of the series was the presence of a highly malignant carcinoma, some of which had a glandular appearance and some was almost epidermoid in type. Columns of simple Brenner epithelium and carcinoma were seen side by side (Fig. 14). Several areas were present in which the transition of simple Brenner epithelium into an epidermoid type of carcinoma could be seen. There seemed little doubt on histological examination that the Brenner cells themselves had become malignant (Figs. 15, 16 and 17).

Several of the tumours were stained with mucicarmine. Nos. 3, 6 and 7 showed no mucin in the Brenner cells. No. 4 showed no mucin in the Brenner cells but the adjacent pseudomucinous cells stained heavily. In No. 8 the Brenner cells did not take up the stain but the secretion in some of the central spaces stained a faint pink. In No. 9 a few of the central spaces of the Brenner columns contained a secretion which stained a faint pink and the secretion produced by the carcinoma and by the pseudomucinous epithelium also stained pink.

The stroma in all these cases follows a general pattern well illustrated by Case 1.

The stroma is dense; long fibrous bands interlace and split to avoid the columns of epithelial cells. Around the columns is a capsule-like condensation of the stroma consisting of a few attenuated fibrous cells running in the direction of the periphery of the cellular columns. Two of the tumours showed calcification and in one there was hyalinization of the stroma around the columns. In tumour 8 which is small the stroma was not completely differentiated from the normal ovarian cortex; in some areas there was a sharp line of demarcation but in others there was no margin between ovary and tumour (Fig. 18).

Discussion

Two generally accepted features of Brenner tumour are that it is a simple tumour and that it has no hormonal influence. Meyer (1932) called attention to these properties and most textbooks and articles published since then reiterate his statement. It is proposed to examine these features more fully.

Malignancy

Brenner tumours are considered to be benign and with very few exceptions there is no evidence

FIG. 1
Case 3. Large Brenner tumour in wall of multilocular cyst.

FIG. 2
Case 6. Uterus with Brenner tumour attached. The pedicle of the endometrial polyp is seen in the left cornu.

FIG. 3
Case 7. Small Brenner tumour incorporated in the ovary.

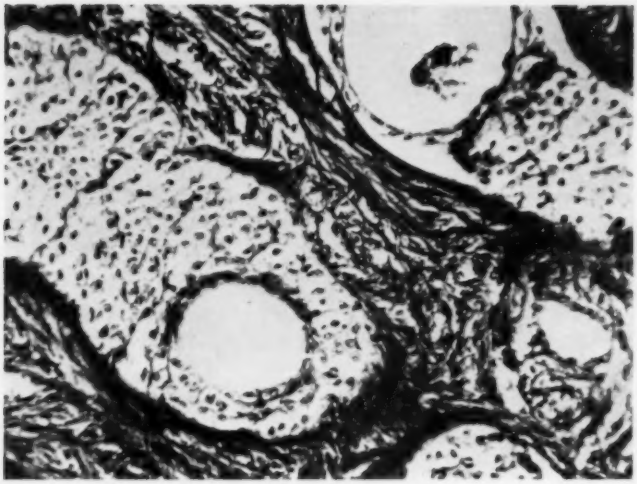

FIG. 4
Case 1. Columns of large pale vacuolated Brenner cells. Note the variation in the lining of the central space. ×225.

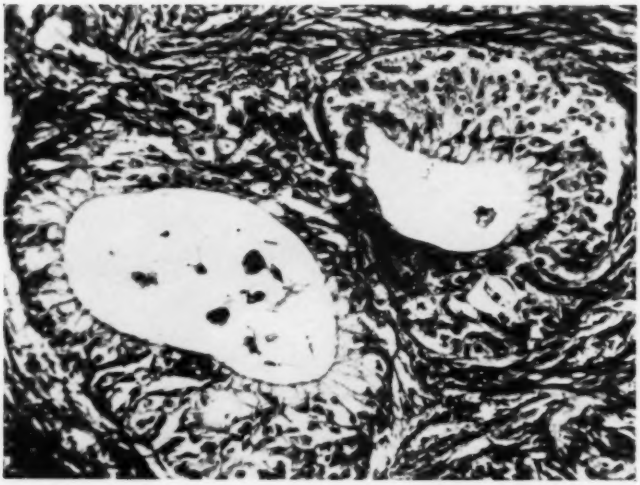

FIG. 5
Case 1. Brenner cells becoming pseudomucinous in type. ×225.

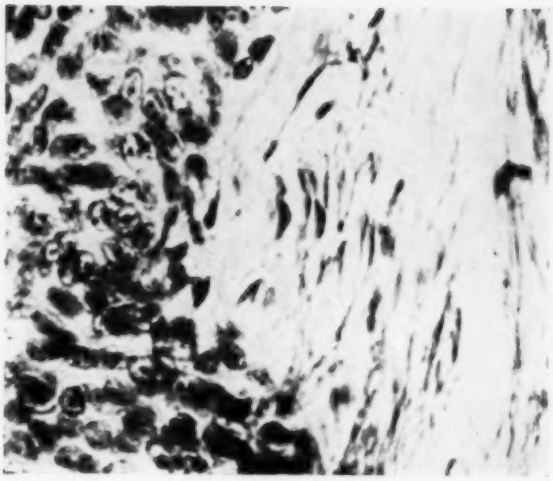

FIG. 6
Case 2. A Brenner column showing deep staining nuclei closely packed together. Minimal cytoplasm. Note the hyalinization of the stroma. ×700.

FIG. 7
Case 2. Shows the well defined cell margins of some Brenner cells. ×900.

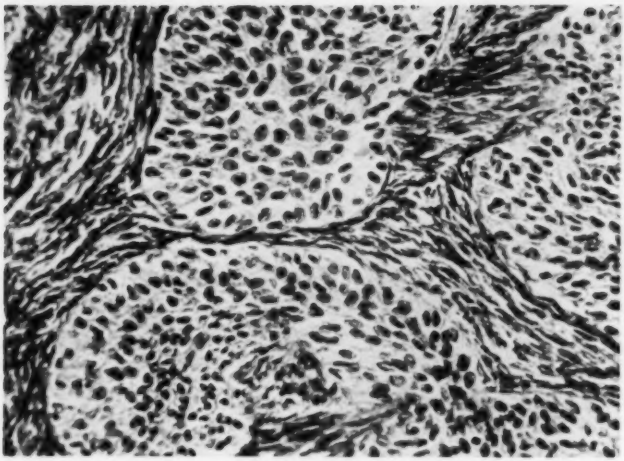

FIG. 8
Case 6. Shows a typical Brenner column. The longitudinal grooves are well seen. ×265.

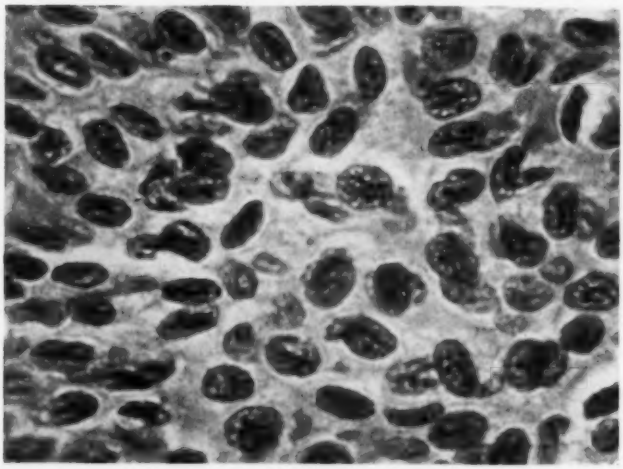

FIG. 9
Case 6. Shows a typical Brenner column. The longitudinal grooves are well seen. ×900.

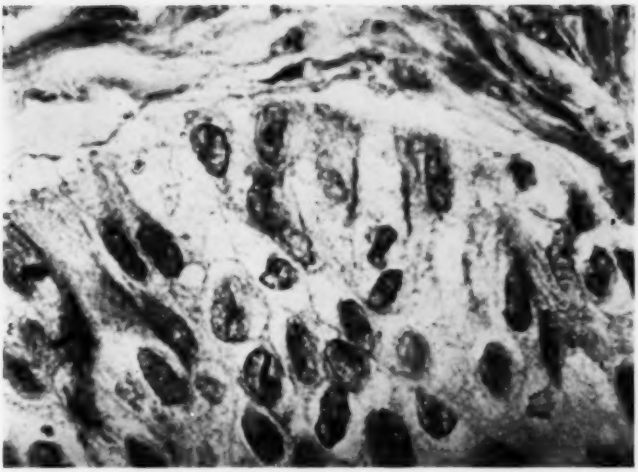

FIG. 10
Case 4. Shows the radial arrangement of cells, the oval and spindle-shaped nuclei and the longitudinal grooving. ×900.

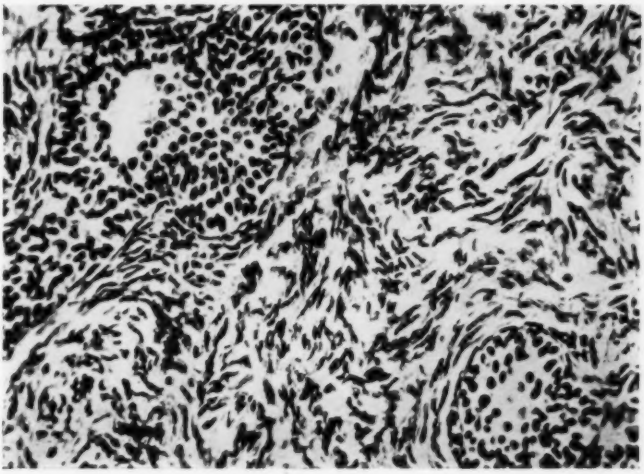

FIG. 11
Case 9. Typical Brenner epithelium showing a radial arrangement of cells. Some of the cells lining the space have become columnar in type. ×265.

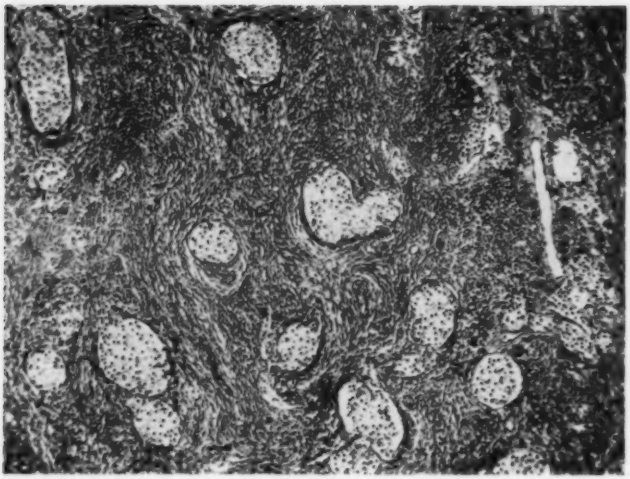

FIG. 12
Case 9. Shows Brenner columns of the "secretory" type. ×50.

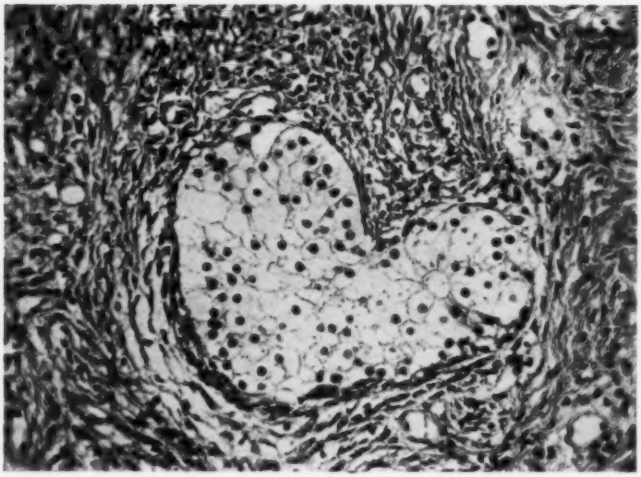

FIG. 13
Case 9. Shows Brenner columns of the "secretory" type. ×250.

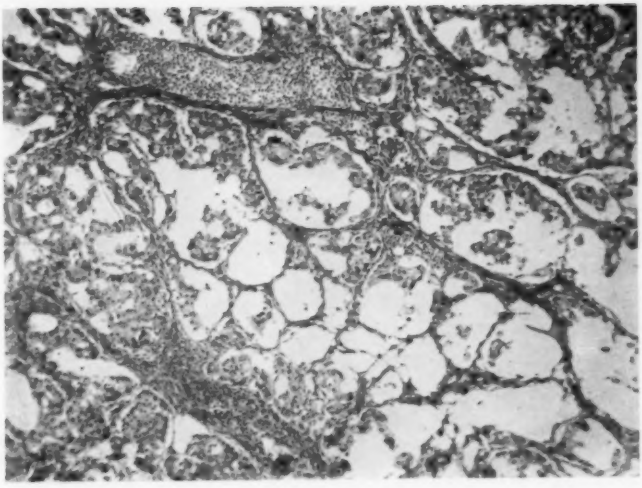

FIG. 14
Case 9. Brenner columns surrounded by carcinoma. ×75.

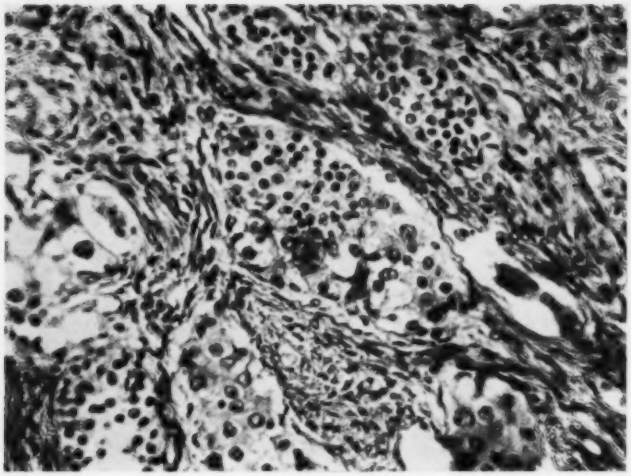

FIG. 15

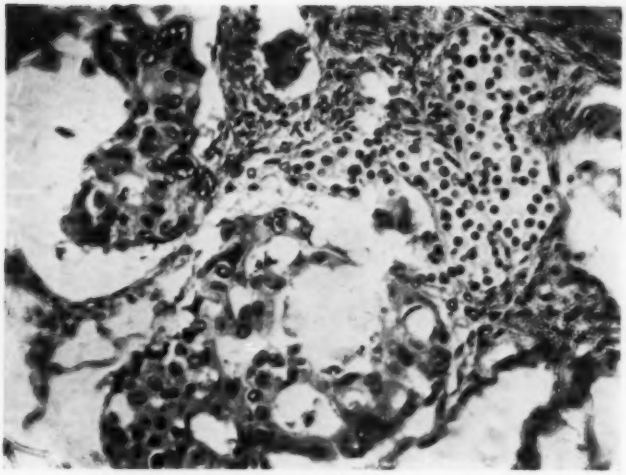

FIG. 16

FIGS. 15 AND 16
Case 9. Two areas which show the transition of Brenner epithelium to carcinoma. ×250.

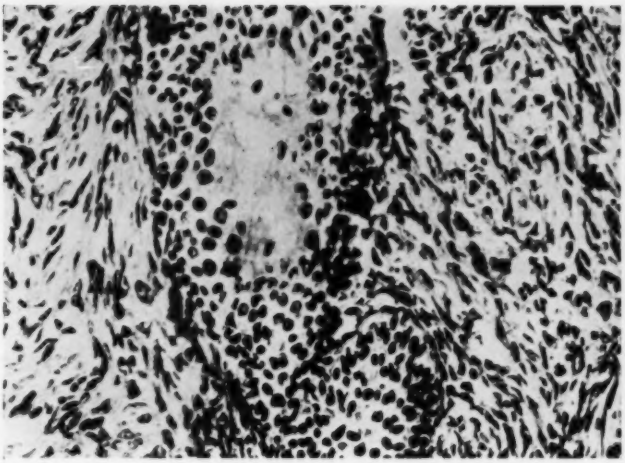

FIG. 17
Case 9. A cord of Brenner epithelium showing abnormal nuclei in the centre. ×265.

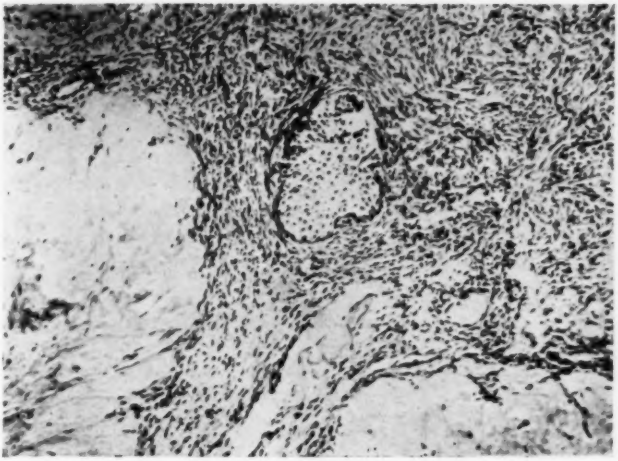

FIG. 18
Case 7. Brenner column between 2 corpora albicantia. There is no dividing line between tumour and ovarian stroma. ×100.

of malignancy either clinically or pathologically. They were not, however, always thought to be so. Most of the early British tumours were examined by the pathological panel of the Obstetrical Society of London and they were reported by the majority of the panel to be carcinomas. When Macnaughton-Jones's (1898) patient was seen in good health 11 years after operation and one of Spencer's (1926) cases 14 years later at the age of 78, there was a tendency to consider the tumours to be benign.

Brenner tumour may occur with other malignancy of the genital tract. In this series Case 7 had an adenocarcinoma of the uterus and it was for this reason that the operation was performed. A case described by Ewald (1934) occurred in association with carcinoma of the cervix. Freund's (1933) second case had a carcinoma of the cervix and Schiller's (1934) second case had a primary carcinoma of the left tube with metastases in the right ovary, in which there was a fibrous knot of Brenner tumour sharply defined from the malignant tissue. One of Varangot's (1938) cases developed carcinoma of the corpus uteri 2 years after removal of the tumour and died 4 years later. Fox's (1942) third case was diagnosed as a bilateral Brenner tumour in association with carcinoid tumour of the appendix. The illustration does not confirm the diagnosis of Brenner tumour; the epithelium is not typical and shows infiltrations rather than columns of cells, suggestive of a secondary carcinoid tumour. Twelve cases of metastases of carcinoid tumour in the peritoneum have been reported (Stewart and Taylor, 1926). In Jondahl *et al.*'s series (1950) 1 case was associated with carcinoma of the body and 1 with carcinoma of the cervix.

Malignant degeneration of the tumour itself is rare but does occur. The possibility that this might occur was suggested by Mandelstamm (1932) of Karkov who quoted *in extenso* the case of Tavildaroff in which a second Brenner tumour developed in an apparently normal ovary 2 months after removal of a large Brenner tumour of the other ovary. This case is inconclusive but is not mythical as seems to be suggested by Andujar, Enloe and Swift (1947).

The first conclusive case was that reported by von Numers (1945). He reported 2 malignant Brenner tumours, the first of which bears a remarkable resemblance to Case 9 of the present series. Dubrauszky and von Massenbach (1947) described a tumour part cystic and part solid taken from a woman of 70 who had a little vaginal bleeding for 2 years. The endometrium showed polypoidal hyperplasia. The tumour showed typical Brenner epithelium, solid carcinoma (some of which looked like granulosa) and adenocarcinoma of the serosal type. They stated that there could be seen "a continuous change between benign and malignant cell formation".

Dubrauszky (1949) himself reported what he described as a second case of cancerous Brenner tumour. This article is rather unsatisfactory. He described a half solid and half cystic tumour; the solid portion was Brenner tumour and the cystic portion was a pseudomucinous cyst. In the cystic area some of the cavities were lined by Brenner epithelium and some by an epidermoid type of carcinoma. The patient had had the left breast removed for carcinoma in 1942 and the glands were irradiated. The ovarian tumour was removed in January, 1949. He says that he has shown that there is a Brenner tumour developing into a cystic tumour and that the cystic tumour shows malignant transition into a type of epidermoid carcinoma, all of which is true; but he does not show the transition of Brenner epithelium into carcinoma. It is true to say that this is a malignant Brenner tumour but not necessarily so that the Brenner epithelium has become malignant. He says that the possibility of metastases from the breast can be excluded because of the good healing of the scar and the lack of recurrence after 9 years and yet only 7 years had elapsed since the mastectomy. The most reasonable explanation of this anomalous tumour is that epidermoid secondaries from the breast have invaded an already existing Brenner tumour.

A true case of malignant Brenner tumour has recently been reported by Rawson and Helman (1955). This case shows clearly malignant cells in the Brenner columns and invasion by cells from these columns. The case was fatal.

Two further cases of malignant Brenner tumour have been mentioned. One was seen by Dockerty and was reported in a personal

communication to Simpson and Branch (1944). (Dr. Dockerty tells me that the tumour was shown to him by Dr. Colvin and thinks that it was not reported in the literature.) Another is the case of Limburg in which the Brenner epithelium developed into epidermoid carcinoma which was reported and illustrated by Novak (1952a).

It is surprising that Brenner tumours do not become malignant more often. It has been shown that there is a very close relationship between Brenner and pseudomucinous epithelium, so close indeed that the one may become transformed into the other. In 24 years 610 pseudomucinous cysts were reported in this hospital; 73 of these (12 per cent) were considered to have undergone malignant change. There is then a considerable likelihood of these tumours becoming malignant. The explanation of the benign nature of Brenner tumours may lie in the hypothesis of Meyer (1932) that, while Brenner tumours and some pseudomucinous cysts have a common origin, not all pseudomucinous cysts arise from the same source.

Bleeding

Many authors are satisfied that abnormal bleeding from the uterus is merely coincidental, that it has no connexion with the presence of the Brenner tumour and that it can usually be explained by a second pathological process (Meyer, 1932; Varangot, 1938; Novak, 1947; Jondahl *et al.*, 1950 and others). This view is generally accepted.

In the present series 1 patient complained of menorrhagia and 3 of post-menopausal haemorrhage. In Case 2 the menopause was not established until the age of 56, and there had been irregular bleeding for 3 months prior to operation at 62; no endometrium was examined. In Case 6 the menopause at 50 was followed by 3 years amenorrhoea when she began to bleed at intervals of 1–3 weeks. A hyperplastic endometrial polyp was removed and the patient was given a menopausal dose of X-rays. She then had no bleeding for 2 years but began to bleed again and the uterus was removed. A polyp 4 cm. long, which showed active proliferation, was found in the cavity but the endometrium and the tubal mucosa were inactive. Case 7 bled vaginally as a result of adenocarcinoma of the uterus and Case 8, who was still menstruating at the age of 54, had menorrhagia. The uterus in the latter case contained a fibroid 5 cm. in diameter and the endometrium showed proliferative activity.

A considerable number of patients who have had Brenner tumours removed have complained of vaginal bleeding but unfortunately it is the exception rather than the rule that the endometrium was examined. All 3 of Fleming's (1929) cases previously reported from this hospital had abnormal bleeding. The first case, aged 43, had 3 weeks bleeding prior to operation. the second had irregular bleeding, precipitated by an abortion, for 3 years before operation and the third, aged 59, had had a blood-stained discharge for a week. Darwall Smith's (1909) case complained of epimenorrhoea. Abraham's (1933) case was bleeding before operation after 5-years amenorrhoea. Fauvet (1935) reported 4 cases of Brenner tumour, 3 of which had abnormal bleeding; one, aged 60, to such an extent that he had diagnosed granulosa cell tumour. Schiffmann (1932) reported 2 cases with bleeding, one of which had cystic glandular hyperplasia of the endometrium. Bland and Goldstein (1935) collected 53 cases in which the presence or absence of abnormal vaginal bleeding was noted; it was present in 19. Marwil and Beaver (1942) described hyperplastic endometrium in association with Brenner tumour and Andujar, Enloe and Swift (1947) reported 2 similar cases. In the latter report the illustrations do not show typical Brenner tumour but the authors say that it was easily recognizable.

Teoh (1953) reported 2 patients who had large Brenner tumours. One, in which bleeding took place long after the menopause, had bilateral tumours and the other, aged 48, complained of a return of the periods after 3-years amenorrhoea.

It is therefore by no means certain that all Brenner tumours have no hormonal effect. Of the 12 cases reported from this hospital 6 had post-menopausal bleeding or upset of menstruation for which no satisfactory explanation could be given. This is too high an incidence to be completely disregarded. As detailed above,

several cases have been reported which showed hyperplastic endometrium. As Teoh (1953) pointed out, the stroma in a Brenner tumour is indistinguishable from that of a thecoma and for that matter from a fibroma. In thecoma it is thought that the stroma itself may produce an oestrogenic hormone; it is quite possible therefore that in some Brenner tumours the stroma may take on this function too.

Histogenesis

Varangot (1938) remarked with some truth that "to explain the origin of Brenner tumours, authors have given free rein to their imagination", but he justified his speculations by quoting Plaut as saying "since the process has never been photographed one can only put forward suggestions".

The majority of writers on Brenner tumours give their opinion on their origin, with the result that many diverse views have been expressed. These theories have been influenced by the authors' interpretation of the histology of the mature tumour.

The striking similarity in appearance of Walthard's cell nests to Brenner epithelium has caused some of the most gifted writers to attribute the origin of the tumour to these nests. Walthard (1903) described at length many of the inclusions which are found in the ovary in an attempt to explain the aetiology of ovarian adenomas. Two of the inclusions which he described as separate entities are now considered to be different manifestations of one group of cells and have come to be called Walthard's cell nests. The first he described were nests of closely packed epithelial cells connected with the surface epithelium and lying just below it or deep in the stroma. He pointed out that Meyer (1903) and Schickele (1902) had already observed these nests on the tubal serosa, the mesovarium and the broad ligament but could not agree with these authors that they were overgrowths of germinal epithelium. Walthard insisted that they were congenital anlage developed from the stroma around them. The second group he described were gland tubules which showed the transformation of squamous epithelium to columnar epithelium and a central lumen usually lined by the latter.

Walthard's nests were later studied by Danforth (1942) who gave a good account of the morphology. They are collections of cells either closely packed together with oval nuclei often bearing a longitudinal groove, or mucoid cells or pseudomucinous cells or any combination of the three. They occur on the surface of the ovary, the mesovarium or the broad ligament and are more commonly seen in very young subjects. The cells of these nests are morphologically indistinguishable from those of Brenner epithelium and they undergo the same transformations.

Meyer (1903) was interested in Walthard's nests even before Walthard described them and it was not without 30 years reflection that he ascribed the origin of Brenner epithelium to them. His opinion is therefore not to be regarded lightly. He suggested that not only Brenner tumours but some pseudomucinous cysts had their origin from these nests. He thought that the ultimate origin of the cell nests was the coelomic epithelium which, in the region of the primitive ovary, becomes Müllerian and may develop abnormally into the Walthard's cell nest. This theory has been supported by many authors including Dubrauszky (1949) and with some reservations by Plaut (1933) and Novak and Jones (1939).

Orthmann (1899) considered that the germinal epithelium was the probable origin of the Brenner tumour and described in the pedicle of his tumour, groups of cells which lay in the stroma near the surface epithelium. These cells were exactly similar to the epithelial tumour cells and may well have been Walthard's nests. He demonstrated the change in character of the epithelial cells. Thus Orthmann and Meyer with similar data came to different conclusions. Von Werdt (1914) stated that his group of tumours originated from granulosa cells but, referring to Brenner's own tumours, not necessarily directly from the mature follicle; as the ultimate origin he suggested the germinal epithelium. Brenner himself (1907) interpreted the epithelial structures as follicles producing ova and thought their origin must be the primordial follicle, a hypothesis which Willis (1948) stated that we may in the future be prepared to re-admit. Schiller (1934) suggested that some of the

tumours might arise from the rete ovarii and in a hilar tumour traced the continuity of the Brenner epithelium with the epoöphoron. He thought that the epithelium might be of Wolffian origin.

Greene (1952) pointed out, as did Arey (1943), that the grooving of the nucleus in both Walthard's nests and Brenner epithelium, which has been the basis of many authors' deductions, was by no means constant in either structure nor was it confined to them. He demonstrated the grooves in squamous metaplasia of the cervix and in a granulosa tumour. Greene showed that Brenner epithelium may have a diverse origin.

In some tumours he demonstrated that the epithelium was continuous with mesonephric elements in the rete (these were mostly tiny hilar tumours), in others he could trace the transition from stromal cells to epithelial cells and showed that in these cases the reticulum of the stroma penetrated the smaller epithelial cords. Reagan (1950) studied serial sections of a Brenner tumour and showed the continuity of the epithelial columns with the surface epithelium of the ovary and suggested that the columns arise from superficial inclusions. Kerpe, Black and Speer (1952) stated that Brenner epithelium was a form of metaplasia of the Müllerian system and that it could be expected to be found outside the ovary. Unfortunately the evidence they produce is most unconvincing. They said that Brenner epithelium occurred in an endometrium which had originally been diagnosed as adenoacanthoma. The illustrations suggest that the original diagnosis was correct and that the ovarian lesion was not a Brenner tumour but adenoacanthosis of the ovary similar to the 40 cases published by Dockerty (1954). Teoh (1953) supported Walthard's opinion that the epithelial elements arose from the stroma and considered that the common precursor of granulosa cell, theca cell and Brenner tumours was the ovarian stroma from which the follicles developed. The difference in appearance of the Brenner cells was merely due to a metaplasia of the epithelial cells.

The stroma of the tumour has been considered by some to be a secondary reaction of the tissues to the presence of foreign elements, a similar process to that which results in adenomyoma of the uterus. Teoh (1953) on the other hand insisted that the stroma was an integral and neoplastic feature of the tumour and showed that it was identical to the parenchyma of thecomatous tumours.

What conclusions may be drawn from all that has been written on the histogenesis of these tumours? Meyer (1932) suggests that they arise from Walthard's cell nests which arise from the coelomic epithelium. Arey (1943) suggests that they both arise from the peritoneal epithelium, Greene (1952) suggests the stroma as an origin. Schiller (1934) suggests an origin from Wolffian elements. There is little concrete evidence to support one of these theories against another and it seems that the more experienced the author the less dogmatic he is, and the more likely to ascribe a great potential for differentiation to the ovarian cells themselves. Thus Novak (1952b) says: "The ovary is a hotbed of differentiating potency. Almost anything can happen in this respect and it often does", and Willis (1948): ". . . the granulosa-like cells, columnar, ciliated and goblet cells or . . . stratified squamous epithelium like that of a Brenner tumour . . . serve to show the variety of structural differentiation of which the gonadal and juxtagonadal tissues are capable".

The study of the normal ovary shows the enormous potentiality of the ovarian cells. The tiny cells which surround the primordial follicles develop into the relatively vast corpus luteum in a very short space of time and the undifferentiated stromal cells which enclose the follicle develop into the highly specialized paralutein cells. Thecal cells and granulosa cells are another example of this property of the stroma. As Greene (1952) suggests, may not the development of Brenner epithelium be another example of this power as may be the formation of other ovarian cysts and tumours. It seems profitless to select one particular group of cells as the starting point of a tumour in such a pleomorphic organ as the ovary.

Summary

(1) The clinical features of 9 cases of Brenner tumour are described and the histology is illustrated. The close relationship of these

tumours to pseudomucinous cysts is stressed.

(2) The tumour has achieved a special group for itself on account of its histological peculiarities. The history of this grouping is traced.

(3) The theories of histogenesis of the tumour are reviewed and the possibility that the epithelial cords may arise from the ovarian stroma by metaplasia is discussed.

(4) Abnormal uterine bleeding is not uncommonly associated with the Brenner tumour and the possibility that some Brenner tumours may secrete an oestrogenic hormone cannot altogether be disregarded.

(5) The epithelial columns may become malignant.

Acknowledgments

My thanks are due to the late Dr. Donald McIntyre, to Dr. J. Hewitt and Dr. W. Clement, for permission to publish clinical details of cases which occurred in their wards; to Dr. A. M. Sutherland for his help in the preparation of the paper and to Mr. Thomas Pearston who took so much trouble in taking the photographs.

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BLOOD PIGMENTS IN HAEMOLYTIC DISEASE OF THE NEWBORN

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IN a previous paper (Bevis, 1953) it was shown that chemical examination of the liquor amnii offered a guide to the prognosis for the infant likely to be affected with haemolytic disease of the newborn. This report drew attention to the discrepancy between the observed icterus index of the liquor and that expected from its bilirubin content, the difference being of some importance in foretelling the development of kernicterus (Fig. 1). This diagram includes new cases and has been modified by the results of a follow-up of the survivors of the previous series; this follow-up has shown that during the last 2–3 years the cases near the "upper limit of normal" have in fact developed clinical signs of kernicterus although this was not apparent when they left the maternity nurseries. Although replacement transfusion prevents the onset of kernicterus it is clearly undesirable for all infants delivered of sensitized Rhesus negative women to have a routine transfusion, the procedure being not without risk, and reliance on purely clinical judgment may lead to the transfusion being too late; for these reasons it has seemed desirable to investigate easier methods of arriving at a prognosis for the individual baby and to try to elucidate something of the natural history of the disease.

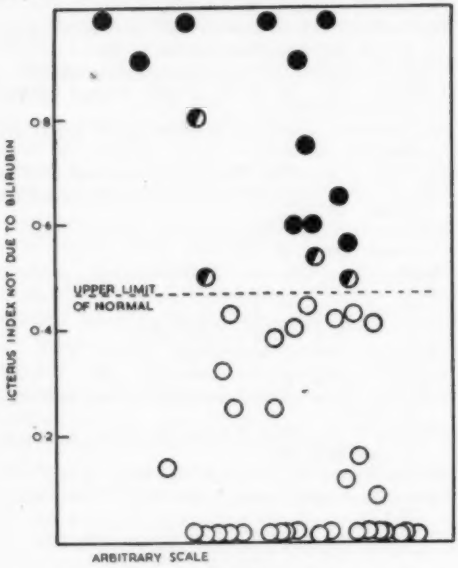

FIG. 1

"Additional" icterus index of liquor amnii.

○ Normal.

◔ Affected but survived.

● Died of kernicterus.

RESULTS

Liquor amnii. A total of 71 specimens of liquor amnii have been examined. These were obtained from 40 sensitized Rhesus negative women, 4 of whom were delivered of children who subsequently developed definite signs of kernicterus, 2 dying.

The liquor was obtained by abdominal paracentesis at intervals, usually fortnightly, throughout pregnancy from the 20th week onwards. Two patients each provided 6 specimens and in the two series of investigations 150 patients have been examined by this method; one patient aborted an abnormal 24-week foetus 2 days after her first paracentesis but no other untoward incidents have occurred.

In a previous paper (Bevis, 1952) the discrepancy between the observed icterus index and that expected from the bilirubin concentration was ascribed to the presence of meso-

bilifuscin but this is wrong; the discrepancy is due to a sharp absorption band with its maximum at 415 mμ (Fig. 2); as additional bands occur at 540 and 575 mμ it would appear that the additional pigment is oxyhaemoglobin. Treatment of the liquor with a reducing agent alters the bands to 430 and 555 mμ while alkaline pyridine with sodium hydrosulphite gives sharp bands at 526 and 557 mμ.

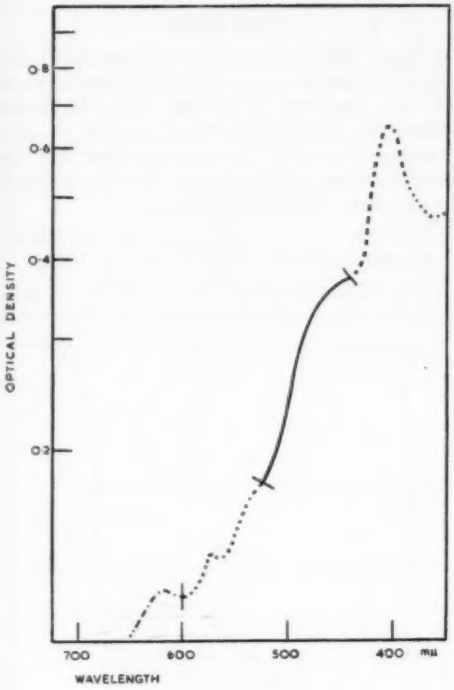

FIG. 2
Typical absorption curve of liquor amnii.

..... Oxyhaemoglobin.
——— Bilirubin.
-·-·- Methaemalbumin.

The spectral absorption curves offer a reliable guide to the subsequent development of kernicterus (Fig. 3) but a better idea is obtained by considering the concentrations of the pigments (Fig. 4). The maximum concentration reached during pregnancy must be considered, the mean values being:

Bilirubin	0·16±0·13 mg. per 100 ml.
Oxyhaemoglobin	0·95±0·36 mg. per 100 ml.

These values give upper limits of normal of bilirubin 0·42 mg. and oxyhaemoglobin 1·67 mg. per 100 ml. and it will be seen that a high concentration of oxyhaemoglobin and bilirubin is followed by kernicterus while a concentration of oxyhaemoglobin within normal limits but associated with a high concentration of bilirubin indicates the development of haemolytic anaemia.

The times at which these pigments appear in the liquor during the antenatal period are of importance; at the 20th week the liquor is usually clear and pigments are not present. After this time vernix appears in increasing

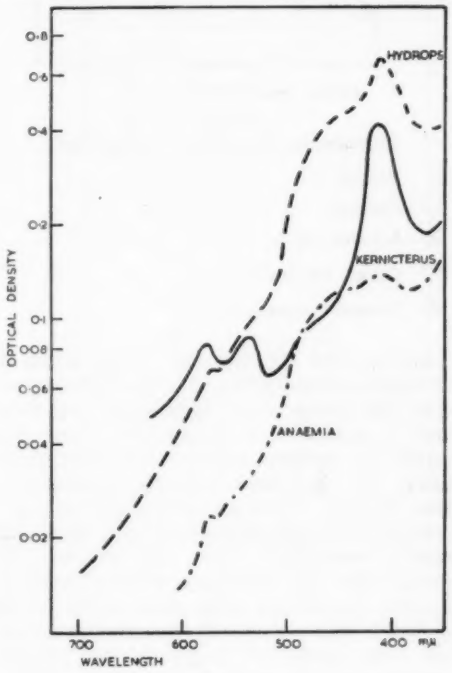

FIG. 3
Absorption curve of liquor amnii from affected cases.

- - - - Hydrops foetalis.
——— Kernicterus.
-·-·- Anaemia.

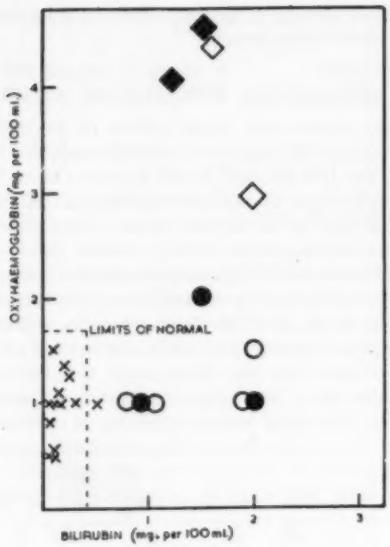

FIG. 4
Concentration of pigments in liquor amnii.

× Normal.
○ Anaemia.
● Anaemia—died.
◇ Clinical kernicterus.
◆ Post-mortem kernicterus.

quantities and the pigments slowly attain a maximum concentration. The haemolytic process may appear quite suddenly at any time and the prognosis is progressively worse the earlier the pigments appear, severe haemolysis before the 32nd week invariably presaging a fatal outcome. There is a definite place in treatment for premature delivery in cases where this sudden haemolysis occurs, but the risks of prematurity must obviously be considered; in practice the problem is the same as that found in cases of pre-eclampsia occurring at about the same period of pregnancy and clinical judgment must be the final arbiter.

The bilirubin is mainly of the type which gives an indirect van den Bergh reaction although up to 20 per cent may be direct reacting. The oxyhaemoglobin resists alkali denaturation (Singer, Chernoff and Singer, 1951) and is thought to be of the foetal type. In 4 cases of foetal death *in utero*, methaemalbumin appeared in high concentration (Fig. 5).

CORD BLOOD

Serum. The findings here are essentially the same as those in liquor. The absorption spectra of the pigments in babies who developed haemolytic disease are shown in Fig. 6; oxyhaemoglobin and bilirubin are present but the concentrations are far higher than those found in liquor, the mean values being:

Bilirubin	$1{\cdot}08 \pm 0{\cdot}65$ mg. per 100 ml.
Oxyhaemoglobin	$7{\cdot}1 \pm 3{\cdot}4$ mg. per 100 ml.

A total of 44 specimens were examined, 7 babies subsequently developing kernicterus. The upper

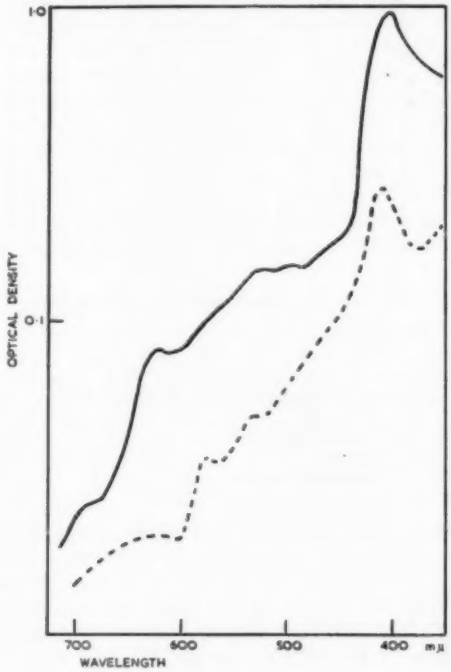

FIG. 5
Pigments in liquor amnii in foetal death *in utero*.

——— Foetal death *in utero*.
----- Liquor containing oxyhaemoglobin for comparison.

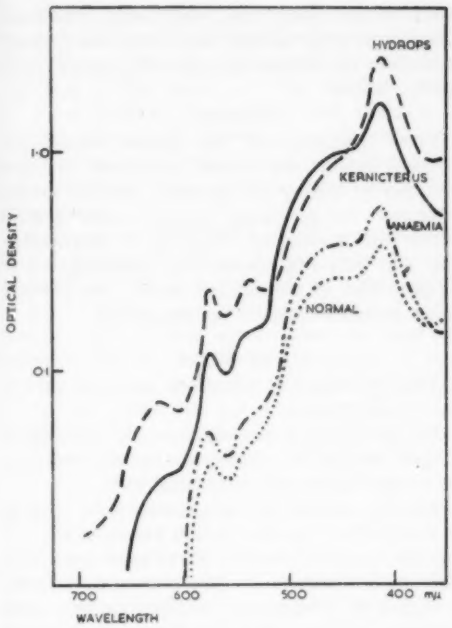

FIG. 6
Absorption curves of cord blood serum from affected cases.

- Normal.
- Anaemia.
- Kernicterus.
- Hydrops foetalis.

limits of normal are bilirubin 2·38 mg. per 100 ml. and oxyhaemoglobin 13·9 mg. per 100 ml.; *in vitro* haemolysis has not proved to be a problem as may be seen from the small scatter of haemoglobin concentrations among the normal cases in Fig. 7.

The bilirubin is mainly of the indirect reacting type and may be present in high concentration but kernicterus developed in one baby whose cord bilirubin was as low as 0·8 mg. per 100 ml. and, although the statement by Hsia *et al.* (1953) that a concentration of more than 5 mg. per 100 ml. in cord serum is likely to be followed by kernicterus is in general true, a better idea of the prognosis is obtained by considering both the bilirubin and the oxyhaemoglobin concentrations (Fig. 7).

The examination of the cord serum provides an alternative to the antenatal examination of liquor amnii and gives an idea of the necessity for a prompt replacement transfusion; it is probable that, if this simple examination were performed more often, many of the routine transfusions now given would be found to be unnecessary.

BRAIN

In the early stages of this investigation there was a lack of tissue for examination but, through the co-operation of Dr. H. S. Baar and others, I have been fortunate in collecting 20 brains from infants dying of kernicterus although 13 of these were the kernicterus of prematurity with no evidence of Rhesus incompatibility.

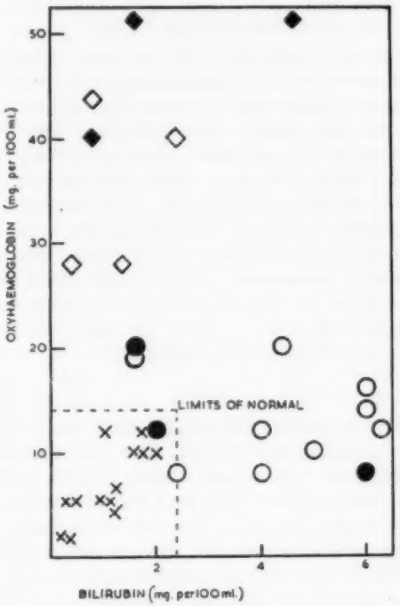

FIG. 7
Concentration of pigments in cord blood serum.

- × Normal.
- ○ Anaemia.
- ● Anaemia—died.
- ◇ Clinical kernicterus.
- ◆ Post-mortem kernicterus.

Chloroform extraction of the pigment in the basal nuclei shows that the predominant pigment is bilirubin although oxyhaemoglobin is associated with this. Chromatography indicates that the bilirubin is of the indirect reacting type. It is not clear whether the haemoglobin is extracted from the vessels supplying the nuclei or whether it is actually deposited in the brain tissue. It is much more concentrated however than in the unstained portions of the brain. No pigment has been found in the nuclei of 10 brains from children dying of other conditions. No difference has been found between the brains of kernicteric premature infants and those with kernicterus due to Rhesus incompatibility and the disease process seems to be the same in both groups of infants.

Cerebrospinal Fluid

The cerebrospinal fluid has been examined in 4 cases of clinical kernicterus and 1 case of severe jaundice due to congenital obliteration of the bile ducts. The specimens from the kernicteric infants were obtained during the first 6 days of life while the congenital obliteration baby was 3 months old. In all the cases of kernicterus the fluid was deep yellow in colour and contained bilirubin of the indirect reacting type, the concentration being about one-seventh that found in serum taken at the same time. No pigment was found in the specimen from the case of obliterated bile ducts.

Teeth

The deciduous teeth of children who survive the brain damage of kernicterus are frequently stained an olive-green colour. Miller (1951) has shown that the pigment is deposited in the dentine layer at the level which was undergoing calcification during the period of jaundice. Miller let me have a specimen of such a tooth and extraction with acid methanol shows the presence of a pigment having absorption maxima at 380 and 640 mμ; treatment with a solution of zinc acetate in ammoniacal alcohol and a small quantity of iodine gives a sharp absorption band at 635 mμ; it appears therefore that the pigment is biliverdin.

It is possible that the dentine is originally stained with bilirubin in the same way as the basal nuclei (they are both very vascular, rapidly growing tissues) and only later does oxidation to biliverdin occur (Forrester and Miller, 1955).

Vernix

Four specimens of the yellow vernix on affected infants have been examined on the first day of life by the methods used for brain pigments. All contained indirect reacting bilirubin with a trace of biliverdin. It is possible that the biliverdin came from meconium but 4 specimens of the normal white vernix from other babies contained no pigments.

Discussion

The investigation has been undertaken for two main reasons.

(1) An attempt has been made to find a simple method for predicting the development of kernicterus in the individual baby.

(2) The solution of the problem of why only a few babies affected with haemolytic disease of the newborn develop kernicterus and why this lesion develops in some premature infants.

Amniotic fluid biopsy appears to be a safe procedure and provides suitable material for the prediction of disease in the foetus. As haemolytic anaemia of the newborn is easily diagnosed, treated and leaves no serious after-effects, its importance is diminishing but the dangers of kernicterus do not need emphasizing and any method of predicting its onset would be of use in clinical practice. The examination of the liquor is simple and rapid and appears to provide reliable results, the concentrations of bilirubin and oxyhaemoglobin indicating the degree of haemolysis occurring in the foetus at the time the specimen is obtained. It must be stressed that the concentrations referred to in the text are all maximum concentrations attained during pregnancy and it is unwise to assess the condition of the foetus at more than fortnightly intervals after the 32nd week of pregnancy as the disease process may develop rapidly. If rapid deterioration occurs, serious consideration should be given to the premature induction of labour. Armitage and Mollison (1953) rightly condemn premature induction of labour as a routine procedure in the Rhesus sensitized patient but there is no doubt that some babies are seriously

affected in the last 2–3 weeks of pregnancy by the sudden onset of a severe haemolytic process; these extra weeks do not materially affect the maturity of the foetus or alter the difficulties of a replacement transfusion and there is a definite place for the procedure in selected cases. In all cases of doubt, clinical judgment must take precedence over the laboratory results by themselves.

If specimens of liquor have not been obtained in the antenatal period, the prognosis can be assessed by the examination of cord blood serum. Abelson and Boggs (1953) have used similar methods and shown that an accurate forecast can be made from the height of the 415 mμ absorption band; the estimation of the actual concentrations of the pigments is a refinement. This examination would obviate the need for routine exchange transfusions for the infants of all sensitized Rhesus negative women as such transfusions are not without risk and are quite unnecessary in a large proportion of cases; it is possible that the examination of cord blood serum in cases of prematurity would indicate the need for treatment and help to diminish the incidence of kernicterus in these cases.

The natural history of kernicterus in the "Rhesus" infant and the premature baby is of great interest. In both groups the clinical features are the same (Gerrard, 1952) and there seems to be no difference between the pigments laid down (Claireaux, Cole and Lathe, 1953); there is now no doubt that the pigment is bilirubin in the main and that this is of the type giving an indirect van den Bergh reaction. The change in optical properties of bilirubin when in protein solutions (Benard *et al.*, 1950) may account for the findings of Vogel (1953) who described the pigment as mesobilirubin; treatment of extracted pigment with zinc and iodine gives the typical band at 635 mμ characteristic of bilirubin (Lemberg and Legge, 1949).

Many theories have been advanced to explain the aetiology of kernicterus, the more recent being that the crucial damage to the brain is caused by anoxia (Govan and Scott, 1953) and by hypoglycaemia (Gerrard, 1952). Neither of these theories takes into account the children suffering from these conditions who do not develop kernicterus and also appears to neglect the fact that kernicterus only occurs in children with a high serum bilirubin concentration. Hsia *et al.* (1953) have shown that a serum bilirubin concentration over 20 mg. per 100 ml. in the first few days of life is extremely likely to result in kernicterus and they take extreme measures to try to keep the concentration below 10 mg. per 100 ml. Day (1947) produced yellow staining of the rat brain by the intracerebral injection of pure bilirubin after preliminary damage by X-rays and Vogel (1953) stained rabbit brain by the direct injection of mesobilirubin; in neither group of experiments was typical kernicterus produced. The only lesions produced experimentally which resemble true kernicterus were those produced by Eyquem (1949) who induced severe haemolysis in newborn kittens and this provides a clue to the disease process. Kernicterus is a disease of the newborn, it does not occur after the first week of life and it is always associated with a high serum bilirubin concentration, the circulating bilirubin being always mainly of the indirect reacting type. Jagguttis (1927) has shown that only indirect bilirubin can cross into the cerebrospinal fluid and in the present series of cases this was found to be the only type present, the concentration being approximately one-seventh that found in the serum. In physiological jaundice of the newborn the concentration of bilirubin in the cerebrospinal fluid is about 1/120th that found in the serum (Roberts, 1928). Further, there is evidence that the blood-brain barrier in the newborn is relatively immature but that development takes place rapidly in the first fortnight of life, thus explaining the time of onset of the disease; the choroid plexus may also be "blocked" if two substances are present in high concentration and one of them may then pass into the cerebrospinal fluid. In kernicterus the concentrations of both bilirubin and oxyhaemoglobin are considerably raised in the serum and under these circumstances it is possible that the bilirubin leaks through and produces its damage by direct action on the basal nuclei. This is not the place to pursue these questions further but these points obviously require additional consideration.

Summary

The pigments present in liquor amnii, blood, brain, cerebrospinal fluid, teeth and vernix have been examined in cases of haemolytic disease of the newborn. In all except teeth indirect reacting bilirubin has been found to be present, usually in association with oxyhaemoglobin. In teeth biliverdin is present.

The concentrations of bilirubin and oxyhaemoglobin in liquor amnii and cord blood serum give an indication of the severity of the haemolytic process in the baby and may be used as an indication for the necessity for therapy.

A tentative hypothesis to explain the onset of brain damage in kernicterus is presented.

This investigation was undertaken while in receipt of a Leverhulme Research Scholarship from the Royal College of Obstetricians and Gynaecologists and my thanks are due to the College for much help. Much help has also been received from Dr. R. M. Forrester of the Department of Child Health, University of Manchester, in obtaining specimens and clinical details and the co-operation of Professor W. F. Gaisford is gratefully acknowledged. My thanks are due to Professor C. H. Gray for help in the preparation of the manuscript.

Technique

Liquor amnii. Specimens have been collected by abdominal paracentesis (Bevis, 1952), 10 ml. being withdrawn. Care has been taken to avoid contamination with blood and, if this occurs, the syringe is washed out and the needle re-inserted at a different point. The fluid is allowed to cool to room temperature and is then centrifuged at 4,000 r.p.m. for 30 minutes. A slight turbidity sometimes persists and complicates the spectrophotometric examination but I have not been able to get rid of this.

Estimations

Spectrophotometry has been done on a Unicam SP600 photometer using 10 mm. cells, the method used being that described by Mellon (1950) for multicomponent analysis.

If the optical density of a solution is plotted on a logarithmic scale against the wavelength, the curve shape is a qualitative identification of the substance present and the vertical height of the curve is a quantitative indication of its concentration. When two or more substances are present in a solution, the optical densities of the constituents are additive (providing there is no complex formation) and the resulting curve enables the substances to be identified and their concentrations estimated. From the curves shown in Fig. 8 it will be seen that at 700 mμ the only absorbency is that due to the turbidity of the solution probably due to the presence of small particles of vernix. Estimation of the optical density of liquor amnii at this wavelength will therefore represent the concentration of these. At 620 mμ the optical density is due to the absorption by the "vernix" and also by methaemalbumin; since the concentration

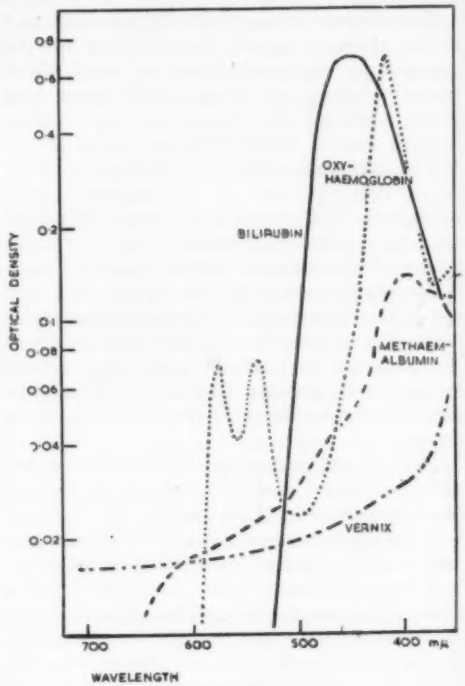

FIG. 8
Absorption curve for pure pigments.

Bilirubin.
Oxyhaemoglobin.
Methaemalbumin.
Vernix.

of the vernix is known, the amount of absorption due to it may be deducted and the resulting figure used to calculate the concentration of methaemalbumin. Similarly, at 575 mμ oxyhaemoglobin has added its absorbency and at 460 mμ the optical density of the liquor is the total absorption by vernix, methaemalbumin, oxyhaemoglobin and bilirubin. The practical application of this is simplified by the fact that the actual concentration of the vernix does not need to be

evaluated and the optical density at 700 mμ may be used as the base line; a transparent reference scale may be constructed with a base line to pass through the optical density at 700 mμ and the increased density marked at 620 mμ; this will then constitute the base for this wavelength. The absorption of standard solutions of methaemalbumin may then be added to this base and the scale used directly for determining the concentration in unknown solutions. The base of a scale at 575 mμ is constructed in a similar manner, the increased absorbencies of the vernix and methaemalbumin being added together and marked above the 620 mμ reference mark. Standard solutions of oxyhaemoglobin give the optical density at different concentrations and the scale used to read the concentration in the unknown solution. All these substances obey Beer's law and intermediate concentrations can be found by interpolation from the known standards. Bilirubin however does not obey this law so that the concentration in liquor must be determined by the use of multiple standards at 460 mμ; the base line at this wavelength is found as before but a large number of solutions of differing concentration must be used to construct the measuring scale. When completed, the transparent scale may be placed over the absorption curve of the specimen of liquor with the base mark at 700 mμ on the curve and the concentrations of all the constituents read directly on the 3 scales.

Cord Blood. The cord is allowed to bleed directly into a receiver, pressure and "milking" being avoided. Care is taken to avoid haemolysis and, after clot retraction has occurred, the specimen is centrifuged at 1,500 r.p.m. for 10 minutes.

Spectrophotometry is carried out as for liquor amnii using a 1 in 8 dilution in 0·04 per cent ammonia solution and 5 mm. cells.

Standard solutions of the pure pigments are prepared by the following methods:

Oxyhaemoglobin—Anson and Mirsky (1930); Bilirubin—Gray (1953); Methaemalbumin—Fairley (1941).

Bilirubin has been estimated on some specimens by the method of Malloy and Evelyn (1937).

Brain. Specimens have been examined as soon after removal as possible. When it has been impossible to arrange collection for some time, the brain has been placed in chloroform after removal and this solvent used if necessary in the subsequent examination. The pigmented areas in the brain are carefully dissected and ground with solvent and acid-washed kieselguhr; after filtration the solution is examined spectrographically.

Chromatography has been performed using the method of Cole and Lathe (1953).

Teeth. Specimens are ground at room temperature to a fine powder and then extracted with solvent and treated as brain tissue.

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DIVERTICULUM OF THE FEMALE URETHRA

BY

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THE earliest description of diverticulum of the female urethra is to be found in William Hey's *Practical Observations in Surgery* published in London in 1803. Eleven years later Sir Charles Mansfield Clarke in his *Diseases of Females* (London, 1814) made the following observation: "sometimes a pouch forms in the posterior part of the urethra in which a few drops of urine lodge and from which situation it may be pressed out by the finger applied to the part". Since then the condition has received but scant attention from British urologists and gynaecologists as judged by the extremely infrequent references to it in the British literature and current textbooks in which diverticulum of the female urethra is either not mentioned at all, or is dismissed in a few lines as being excessively rare.

This is in marked contra-distinction to the state of affairs in the United States. Beginning quite suddenly in 1931 there has occurred in the American literature an increasing flow of papers on this subject. At first a few cases only were reported from any one centre but several large series of proven cases have now been published; for example, 71 from the Mayo Clinic in 1949, 30 from the Johns Hopkins Hospital in 1950, and 45 from the Cleveland Clinic in 1954. The result of this awareness of and interest in the condition can be seen in the standard American textbooks, many recent editions giving excellent descriptions of the female urethral diverticulum and its treatment.

The question arises: is urethral diverticulum common in the United States and rare in Great Britain, or is it seldom diagnosed in Great Britain because it is overlooked? That the latter may be true is suggested by the experience in many of the American centres in which the diagnosis is now relatively frequent. Thus, up to 1941, there were only 6 cases of diverticula in the records of the Cleveland Clinic; these were reported by Engel (1941), who thus drew attention to the condition, and over the next 13 years 39 more cases were described. At the Johns Hopkins Hospital only 30 cases were diagnosed during the sixty years 1890–1949; during the 5 years since the publication of Wharton and Kearns's paper in 1950 as many cases again have been diagnosed. At the University of California only 2 cases of urethral diverticula were recorded prior to 1936, but after these cases were demonstrated to the urological staff 9 more cases were found within one year (Johnson, 1938). So far as can be ascertained no urethral diverticula had been diagnosed in Jamaica before January, 1954 when the first patient in this series of 8 cases presented herself at the University College Hospital of the West Indies.

The possibility that some diverticula are overlooked is also emphasized by the previous history of cases reported in the literature, in many of which there was considerable delay in arriving at the correct diagnosis. Gilbert and Cintrón (1954) estimate that their cases were seen on an average by nine physicians before the diagnosis was made. Wharton and Kearns (1950) describe a case where the diverticulum was missed by a urologist although it contained stones which had previously been demonstrated by X-ray; and another where the family doctor diagnosed the diverticulum after the urologist had missed it completely. In the present series erroneous diagnoses of cystocele, Gärtner's cyst and sub-urethral abscess had been made.

This ignorance of the condition is the direct result of the failure to mention it to students in most teaching hospitals. Gilbert and Cintrón (1954) investigated 50 teaching programmes in

urology and gynaecology in the United States and reported that "a discussion of diverticula of the female urethra is overlooked in the curriculums of most medical schools". An analysis of a questionnaire sent to 41 teaching schools in Great Britain and Ireland reveals that there is little interest displayed in the condition—only 20 replies were received. Diverticulum of the female urethra is not mentioned either in systematic lectures or during instruction in the wards in the great majority of schools. Eight gynaecologists could recollect diagnosing the condition and only 5 of these regarded it as being of any importance.

While diverticulum of the female urethra is obviously not common in Great Britain the above considerations nevertheless suggest that the condition is less rare than most gynaecologists at present believe it to be.

Aetiology

The aetiology of diverticulum of the female urethra is not fully understood. There are three possible causes—infection, trauma and congenital abnormality. Of these most workers consider infection the most likely. Krieger and Poutasse (1954) state: "infection of the peri-urethral glands and ducts occurs, followed by obstruction and abscess formation. Rupture of the abscess into the urethra occurs allowing free communication between the urethra and infected gland." It is believed that once the sac is developed it will tend to enlarge as a result of urinary pressure during micturition (Furniss, 1935). The principal arguments against this theory are that: (1) even where the diverticulum is of considerable size there is usually no history suggestive of a previous abscess; (2) the female urethra is often the site of non-specific infection on account of its exposed position; if such infection played an important part in the aetiology of diverticulum one would expect this condition to be more frequent; and finally (3) there is some doubt whether peri-urethral glands do in fact exist to become infected or distended. The principal evidence for the existence of these glands is provided by Huffman (1948). He examined 11 urethras, making serial sections and wax reconstructions of the entire urethra and its surrounding structures, and demonstrated "that there are numerous ducts and epithelialized pockets which empty into the distal third of the female urethra. Relatively few large ducts open into the proximal urethra." He regarded these as vestigial remnants, probably of the peri-urethral ducts which grow out from the urethra of the foetus before sex determination has appeared and which become the glands of the prostate in the male, but which in the female for the most part disappear (Felix, 1912). They have no appreciable function. Some authors, however (Cabot and Shoemaker, 1936; Counseller, 1949), believe that the urethra is devoid of glands except those described by Skene. Others, though impressed by Huffman's work, emphasize the need for further study of the female urethra before the existence of such glands can be accepted; thus Wharton and Kearns (1950) comment: "it would have been even more convincing if, before cutting his blocks, he had first distended the urethra by some fixing fluid to completely obliterate all folds in the urethral mucosa and eliminate any possible confusion they had always caused in former studies."

Trauma, with or without associated sepsis, has also been suggested as a cause of diverticulum; difficult childbirth, urethral instrumentation and the passage of a calculus, are all given as possible aetiological factors (Downer and Virgilio, 1945). The trauma is thought to result in local damage to the urethral muscle so that a bulge appears which gradually increases in size due to the intra-urethral pressure during micturition. It is now generally accepted, however, that obstetrical trauma is more likely to cause dislocation of the urethra and it is difficult to understand how trauma could produce the characteristic sac of a urethral diverticulum, with its narrow neck, muscular wall and epithelial lining.

The third possibility, that the diverticulum is due to a congenital abnormality of the urethra, has fewer protagonists yet it would seem to fit the anatomical and clinical facts best of all. Most diverticula are situated behind the middle of the urethra and are quite constant in position. The sac is lined by squamous, transitional or columnar epithelium although part or all of this may be destroyed by subsequent infection. While

it is possible that epithelium might grow down into an abscess cavity from the urethra, it is highly improbable that it would do so if the sac were grossly infected; and if the epithelium is columnar or cuboidal it cannot represent a downgrowth of the transitional epithelium lining the urethra. The diverticula described in newborn infants and very young children (de Bary, 1894; McMahon, 1946) can hardly be other than congenital in origin.

On the whole it seems most likely that the urethral diverticulum represents an abnormal development of one of the peri-urethral ducts which, without doubt, are present in every foetus before sex determination occurs but which normally diminish in size or disappear in the female but develop to form the prostate in the male.

As in the bladder or the colon, a urethral diverticulum may remain symptomless unless trauma and infection lead to stasis in the sac and abscess formation.

Anatomy

Size. Diverticula have been described varying from 3–80 mm. in diameter, the average being 20–30 mm. In this series the largest was 50 by 30 mm., and the smallest 15 by 15 mm.

The sac may extend the whole length of the urethra lying against the internal sphincter or the base of the bladder; or it may partly encircle the urethra.

Table I

Anatomy and Bacteriology of the Urethral Diverticula

Case	Number	Dimensions (Cm.)	Site Relative to Urethra	Size of Ostium (Cm.)	Lining Epithelium	Contents	Bacteriology	
							Diverticulum	Urine
1	17751	2·5 × 1·5	Middle 2/4	0·2 × 0·2	Transitional	Pus	Sterile	Klebsiella Few pus cells
2	16183	3·5 × 2·5	Middle 2/4	2·0 × 0·4	None seen	Urine	Sterile	Sterile No pus cells
3	17064	1·5 × 1·5	Middle 1/3	0·3 × 0·3	Stratified Squamous	Saneous Pus	Sterile	Sterile No pus cells
4	12758	5·0 × 3·0	Upper 3/4	0·1 × 0·1	None seen	Saneous Pus	Ps. Aeruginosa	Ps. Aeruginosa Strep. faecalis No pus cells
5	20228	3·5 × 2·5	Middle 2/4	0·7 × 0·2	Columnar	Pus	Klebsiella	Klebsiella No pus cells
6	22407	3·0 × 2·0	Middle 2/4	0·2 × 0·2	Stratified Squamous	Saneous Pus	B. Proteus	Sterile No pus cells
7	21923	3·5 × 2·5	Middle 2/4	—	—	Urine	B. Proteus	Sterile No pus cells
8	22158	3·0 × 3·0	Middle 2/4	0·7 × 0·5	Columnar	Urine	Klebsiella	Klebsiella No pus cells

Patient No. 7 has no symptoms and has not been operated on.

Ostium. Little exact information is available; in 37 reported cases, including the 7 in this series, where detailed descriptions were given, only one sac (Case 3) opened on the lateral aspect of the urethra. All the other ostia were on the vaginal aspect, 10 in the upper third, 18 in the middle third and 9 in the lower third. Counseller (1949), reporting 71 cases, states that "the opening is usually in the middle third of the urethra and in the midline".

Wall. In all our cases the wall of the sac was composed of bundles of smooth muscle running in different directions with interstitial collagen fibres; it was 2–4 mm. thick and was easily dissected.

Lining Membrane. Since in general only those diverticula are removed in which infection causes symptoms, few will retain an intact epithelial lining and many will have only scattered foci of intact epithelium. All the present cases showed severe ulceration of the lining epithelium. In 2 epithelium could not be found, in 2 there were areas of columnar epithelium, in 2 stratified squamous epithelium and, in 1 transitional epithelium was present. One showed areas of columnar epithelium where the inflammation was slight and in other sections where the inflammation was heavy stratified epithelium of transitional type was found. We believe that this is an example of metaplasia in the presence of infection. It may explain why diverticula of congenital origin are often lined by stratified epithelium.

Bacteriology

The contents of the diverticulum and a catheter specimen of urine were cultured in all cases; in 2 the culture remained sterile; in the other 6 a variety of non-specific organisms were grown but no gonococci were found (Table II). There is little information on this subject to be gleaned from the literature. Gilbert and Cintrón (1954) took cultures from 4 of their 8 cases and all revealed *Bacterium coli.* Wharton and Kearns (1950) found gonococci in 10 per cent of their 30 cases and non-specific organisms,

Table II
Symptoms of the Urethral Diverticula

Number		Age	Parity	Symptoms	Duration of Symptoms
1	17751	34	3	(1) Slow micturition. (2) Lump in vagina. (3) Purulent discharge from urethra.	5 years
2	16183	50	1	(1) Frequency of micturition. (2) Dribbling of urine after micturition.	3 years
3	17064	48	4	(1) Painful micturition.	5 years
4	12758	27	3	(1) Purulent discharge from urethra. (2) Dribbling of urine after micturition.	6 months
5	20228	26	5	(1) Painful micturition. (2) Pyrexia associated with acute inflammation of the diverticulum. This patient was known to have a diverticulum before she developed symptoms of diverticulitis following abortion.	3 days
6	22407	25	5	(1) Dyspareunia; the pain was felt in the suprapubic region. (2) Burning on micturition.	2 years
7	21923	29	1	This patient noticed shreds in her urine and slight stress incontinence after delivery. She has no symptoms six months later and has not been operated on.	—
8	22158	49	7	(1) Pain above the symphysis pubis. (2) Frequency and urgency of micturition.	2 months

usually Gram-positive cocci, *Bacterium coli* and diphtheroids, in 90 per cent.

Calculi did not occur in this series. It is said that they are to be found in about 10 per cent of cases and may be single or multiple.

Associated abnormalities of the urinary tract are rare, but diverticulum of the pelvis of the ureter, and opening of a ureter into the urethral diverticulum have been described (Willmarth, 1948; Fromme, 1913). Full investigation of the urinary tract should always precede excision of the diverticulum.

Racial Incidence

There are insufficient data in the literature to determine the racial incidence accurately. Herman and Green (1944) assert that urethral diverticulum is commoner in the negress. There is no evidence to confirm this satisfactorily; indeed, all the 75 cases reported by Wharton and Kearns (1950) from Baltimore and Krieger and Poutasse (1954) from Cleveland occurred among white women. It seems obvious that the racial representation in any given series will reflect that of the local population from which the patients are derived; thus it is not surprising that the 8 cases now reported from Jamaica (where the population is 95 per cent negro or part-negro) should be in coloured women (African-Caucasian 7, African-Asiatic 1).

Symptoms

A diverticulum which is not infected will not usually cause symptoms unless it is very large, when the patient may complain of a swelling in the vagina, or may note that almost immediately after emptying her bladder she feels the urge to do so again. Nocturnal enuresis has been described in young children with this condition (McMahon, 1946).

If the diverticulum becomes infected, and this is especially common after marriage, childbirth or urethral instrumentation, more troublesome symptoms ensue. These include pain, either in the vagina or in the supra-pubic region. The vaginal pain may be associated with a burning sensation on micturition or may be felt only during coitus. Supra-pubic pain may be due to an associated cystitis or may be referred from the urethra without any complaint of localization in the vagina. There were 2 such cases in the present series (Nos. 6 and 8); pressure with the finger on the diverticulum caused pain referred to the area immediately above the symphysis pubis. Some patients with infected diverticula complain of a discharge which, on examination, is seen to be coming from the urethral orifice. All patients in the present series complained of urinary symptoms; the details are presented in Table II.

Diagnosis

The most important factor in the diagnosis of urethral diverticulum is to be aware that the condition exists and is not very rare.

A mass is found behind the urethra, generally about its middle third (Fig. 1) and pressure upon this causes a discharge of urine or pus from the urethral meatus. The volume of fluid expressed will vary with the fullness of the diverticulum at the time of examination, and is usually greatest after micturition.

The diagnosis may be confirmed by urethrography and this has been done in all our cases. Several methods of filling the sac have been described, of which two have been successfully used in this Unit.

Gilbert and Cintrón (1954) give Taylor's technique as follows: "a silk ligature is placed distal to the bulb of a No. 20 Foley catheter and an orifice is cut immediately proximal to the bulb. After the catheter is introduced through the urethra into the bladder the bulb is distended and pulled snugly against the sphincter. After the air is forced from the catheter the external urethral meatus is pinched about the catheter and the urethra is filled with Diodrast; X-rays are taken in the antero-posterior and lateral directions." We have found this to be the most satisfactory method.

We have also used successfully on several occasions an adaptation of Robert's method of cystourethrography (Roberts, 1952). The bladder is emptied through a catheter and 4 ounces of sodium iodide are introduced; 15 ml. of viscous diodone is then introduced. The patient stands up and micturates into a kidney dish held between her legs while an oblique X-ray is taken. This technique is less satisfactory than Taylor's method because the diverticulum does not fill so well (Fig. 3).

FIG. 1
Urethral Diverticulum.

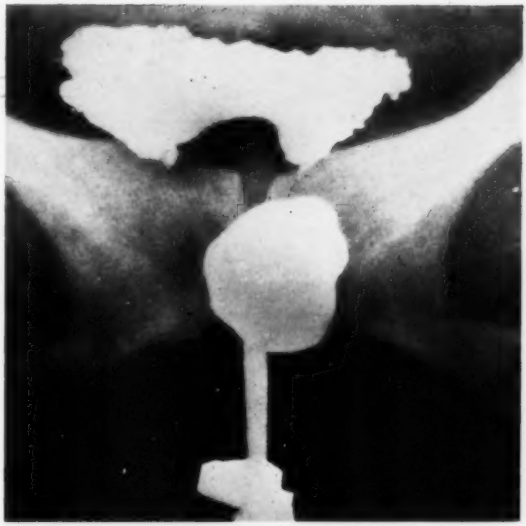

FIG. 2
Cystourethrogram, antero-posterior view (Taylor's method). A fairly large diverticulum is clearly shown. The filling defect in the bladder is due to the water-filled balloon of the Foley catheter.

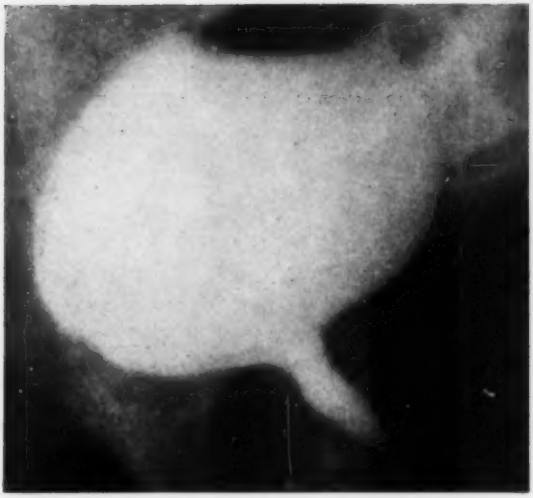

FIG. 3
Cystourethrogram during micturition, oblique view. The diverticulum is smaller than that shown in Fig. 2 and is only partly filled with opaque fluid.

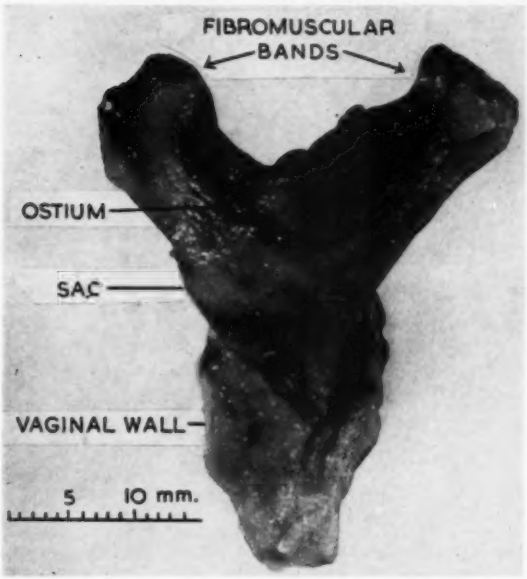

FIG. 4
A diverticulum after excision, seen from the urethral aspect. The vaginal skin was redundant and was removed attached to the sac. ×2·5.

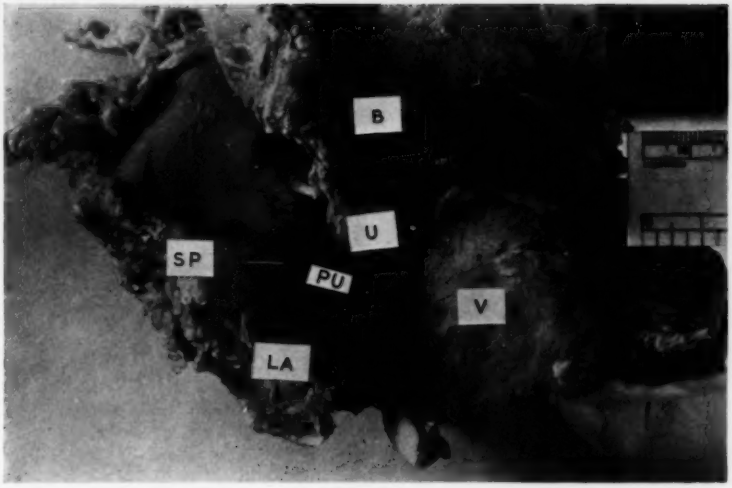

FIG. 5

A dissection of an adult female pelvis to show the pubo-urethral division of the left levator ani muscle. The bladder and urethra have been distended with gelatin and are displaced backwards and to the right. The vagina has been dissected off the urethra in its upper two-thirds.

B = Bladder. U = Urethra. V = Vagina. S.P. = Symphysis pubis. L.A. = Pubo-coccygeus. P.U. = Anterior part of pubo-coccygeus which is inserted into the postero-lateral aspect of the lower part of the urethra.

It may be possible to identify the orifice of the diverticulum through the panendoscope or the Kelly cystoscope, and a ureteric catheter may then be passed directly into the sac. Radio-opaque fluid is injected and X-rays taken in the antero-posterior and lateral positions. Counseller (1949) points out, however, that it is not always possible to identify the ostium even after repeated attempts. This has also been our experience.

Differential Diagnosis

Urethral diverticulum must be distinguished from other conditions which cause a swelling behind the urethra, for example Gärtner's cyst, the dislocation of the urethra often associated with cystocele, retention cyst of Skene's gland, a urethral abscess, adenocarcinoma of the urethra, and the retro-urethral fullness due to increased vascularity and softening of the vaginal skin during pregnancy.

A discharge from the meatus on stripping the urethra is characteristic of urethral diverticulum but is more commonly due to chronic urethritis; occasionally a discharge of epithelial debris-laden material can be expressed from a normal urethra.

Complications

Infection is generally present in a diverticulum which is causing symptoms, other than those due to pressure from a large sac. Ascending urinary infections may result from an infected diverticulum and this should always be looked for in cases of unexplained recurrent cystitis or pyelitis.

Calculus formation in the diverticulum is said to occur in about 10 per cent of cases and is usually accompanied by infection, pyuria and symptoms of persistent cystitis (Wharton and Kearns, 1950; Herman and Greene, 1944).

Fistulae are rare but may occur after labour or following attempts at excision of the diverticulum (Scott and Ekas, 1946). It has been suggested that the fistulae which occasionally follow an apparently straightforward anterior colporrhaphy may in some instances be due to injury to an undiagnosed diverticulum.

Two cases of adenocarcinoma arising in a diverticulum have been described (Hamilton and Leach, 1951; Wishard and Nourse, 1952).

Treatment

There is general agreement that if it is causing symptoms "the best treatment is complete surgical excision of the diverticulum and repair of the urethra" (Counseller, 1949). If there are no symptoms it may be justifiable to temporize, but it should be remembered that adeno-carcinoma may develop in a urethral diverticulum.

As the sac is usually infected it is advisable to determine the bacteriological content of the bladder urine and the fluid in the sac, and take steps to control the infection before operation, continuing treatment afterwards until the catheter is removed from the urethra.

The 7 cases operated on in this series developed post-operative pyrexia varying from 99° F. to 104° F. All received antibiotics or sulphadimidine and all healed rapidly and satisfactorily.

The essential points in the operation are the dissection of the sac, its excision and the closure and support of the urethra. The sac may be incised first and dissected when the relationship of the ostium to the urethra can be clearly seen (TeLinde, 1953), or it may be dissected out intact before removing it from the urethra. In this series both techniques have been employed; the only difficulty in the separation of the sac arose regularly at its supero-anterior aspect due to a fibro-muscular band which passed back from the diverticulum lateral to the urethra to the back of the symphysis pubis. It corresponded both in position and histological structure with the anterior part of the pubo-coccygeus muscle which is inserted into the urethra (Curtis, Anson and Ashley, 1942) (Fig. 5). In 6 cases there was a small recess a few millimetres in depth at the attachment of the fibro-muscular bands. In order to remove all of the diverticulum it was necessary to dissect out the bands, clamp and divide them, afterwards replacing the proximal clamp with a catgut ligature.

During the dissection care must be taken not to injure either the urethra or the bladder if the diverticulum is large enough to impinge upon its base. The urethra was closed over a metal catheter with interrupted inverting sutures of twenty days 00 catgut, and the vaginal wall was closed in two layers with interrupted

sutures of twenty day No. 2 catgut. A cuffed rubber catheter was inserted and anchored to a silver wire suture near the meatus; it was removed 3 to 5 days later. In 6 of our cases normal micturition occurred immediately thereafter.

In 2 there was retention of urine and the cuffed catheter was replaced for a further 48 hours after which no further difficulty was encountered. Repeated catheterization was thus avoided with its inherent risk of damage to the urethral repair. Vaginal cystostomy was performed in the first case in which the ostium was unusually large (2·0×0·4 cm.) but this was probably unnecessary and no cystostomy was performed on any of the other 6 cases operated on. The average post-operative stay in hospital was 15 days.

Results

It is too soon to assess the results of surgery completely as all the cases were operated on during the past year. So far there is no evidence of a recurrence in any, and the symptoms due to the diverticulum are cured in all of them. The division of the pubo-urethral muscle has not had any untoward results.

Summary

A series of 8 urethral diverticula diagnosed at the Department of Obstetrics and Gynaecology of the University College of the West Indies in just over one year is described.

A review of the literature is presented. Emphasis is made on the frequency with which this condition is overlooked in clinical practice.

Investigation shows that most British medical schools do not include any mention of urethral diverticulum in their teaching programmes.

Evidence is presented to show that urethral diverticulum is usually of congenital origin.

Acknowledgments

I am indebted to Professor Stewart for his advice in the preparation of this paper and to Professor Hill of the Department of Pathology for his help in the investigation of the pathology of the diverticula.

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PROLONGED FIRST STAGE OF LABOUR

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PROLONGATION of any of the three stages of labour is a common obstetrical problem. It is on the prolonged first stage of labour that we wish to focus attention.

The danger of prolonged labour was well known to obstetricians in former years and it is interesting to find that Sir James Y. Simpson (1848), over a century ago, stated that when labour lasted over 36 hours 1 in 6 mothers and 1 in 2 babies died. More recently Bourne (1933) found that when labour lasted over 48 hours the maternal mortality was 10 per cent and the stillbirth rate 38 per cent. MacRae (1949), in postwar years, described a series of cases of primary inertia, which included all cases of labour over 48 hours except contracted pelvis. He found that the maternal death rate was 0·47 per cent, while the foetal loss was over 12 per cent.

It is difficult to define when labour is to be termed protracted because its length, as judged by the clock, is not always a satisfactory guide. We do feel, however, that each obstetrician should choose a critical time beyond which labour is not allowed to drift on, but which receives careful and repeated assessment. In our opinion the 30th hour is the time to review in detail the progress and prognosis of a continuing labour. Often at the critical hour a successful termination of labour is obvious as the second stage is in being or nearly so. If not, an attempt is made to find out why labour is delayed, to assess the general condition of mother and baby and to make a prognosis as to the probable course of labour and to estimate the chances of a safe vaginal delivery.

THE DANGERS OF PROLONGED LABOUR

Maternal Mortality

In the decade 1940–49, out of a total of 124 maternal deaths in the Simpson Memorial Maternity Pavilion, 31 were in patients who had been over 30 hours in labour. Of these, 26 were primigravidae and 5 multiparae. The main cause of death was sepsis (13 cases); then followed post-partum shock and haemorrhage (10 cases). The remaining causes of death were rupture of the uterus 3, pulmonary embolism 2, and hepatic toxaemia 3. It should be noted, however, that there has only been 1 death from sepsis in these cases of prolonged labour since 1944. As Sheehan (1947) showed, post-partum shock is now the major killer when labour has been prolonged beyond 48 hours.

In order to assess maternal morbidity and foetal wastage, we have taken all the cases in which labour lasted over 30 hours in the years 1940–41 and 1948–49. We chose the years 1940 and 1941 because these were the first two complete years after the Simpson Memorial Maternity Pavilion was opened. For comparison of results we chose the years 1948 and 1949, by which time the commoner antibiotics were in general use, treatment had become more radical and the full obstetrical staff was again available. In these two periods the incidence of labours lasting over 30 hours fell from 12 per cent to 8·7 per cent. The maternal mortality in these cases of prolonged labour fell from 15 cases to 1 case.

Maternal Morbidity

The maternal morbidity rate was nearly 3 times greater in the earlier years—17·6 per cent as against 7 per cent. The combined rate for both periods was 5 times as high as the general rate for the hospital. It was also found that the maternal morbidity rate rose as the duration of labour increased.

Foetal Dangers

Out of a combined total for the two groups of 1,288 cases of labour lasting over 30 hours, only 171 were multiparae. In our series the foetal loss was more than twice as high in these multiparae as in the primigravidae, 22·12 per cent as against 9·7 per cent. It was found that the total stillbirth and neonatal death rate in all our cases of prolonged labour was appreciably higher than the rate for the hospital as a whole, and this, of course, is a group of cases where prematurity is infrequently a factor. We were surprised and disappointed to find that the difference in the total foetal loss was only 3 per cent in the two periods under review compared to the improvement in the maternal mortality—from 15 cases to 1.

The main cause of foetal death is intra-partum asphyxia, although in the earlier war-time period the absence of a post-mortem in over half the cases tended to hide this fact. In the latter period under review, in which post-mortems were done in all cases, asphyxia was found to be 8 times as frequent as cerebral haemorrhage. This corroborated Cruickshank's observations (1930). He recorded that direct damage to the respiratory centre by oedema produced by prolonged and excessive intracranial pressure, rather than intracranial haemorrhage, was the commonest post-mortem finding in these babies.

Early rupture of the membranes may exert a deleterious effect on the child, but, as Eastman pointed out, the harmful effect is not enough to warrant free recourse to abdominal delivery on this score alone. Foetal distress and intra-uterine death can occur with intact membranes. Although preservation of the amniotic sac is usually considered advantageous during a long labour, it is often good practice to rupture the membranes artificially. By so doing, the presenting part may come down onto the cervix and thus stimulate and improve uterine action. Meconium may be found in the liquor amnii, and, if thick and fresh, is indicative of real foetal distress. If no advance follows rupture of the membranes a decision to interfere is often expedited.

It is generally accepted that in primigravidae the foetal loss rises with the age of the mother. In the latter period under review there was a marked fall in the foetal loss in the age groups 30 to 39 and over 40 years as compared with the former period from 18·2 per cent to 10·5 per cent and from 32 per cent to 21·7 per cent respectively. This was in large measure due to the earlier resort to Caesarean section in the older age-groups in the second period.

Investigation and Diagnosis of Cause of Delay

In order to diagnose the cause of delay, both abdominal and vaginal examination are necessary. Reliance should never be placed on rectal examination in these potentially difficult cases. If doubt arises as to progress there must be no hesitation in repeating the vaginal examination as often as necessary. In obese cases and in those in whom a pelvic bony abnormality is suspected, a lateral X-ray picture is invaluable.

As well as elucidating the cause of delay an attempt should be made to assess the chances of a successful vaginal delivery. This necessitates taking into account the present general condition of mother and foetus. A difficulty immediately arises when the cause of delay is sought, for so often there is a combination of faults in the powers, the passages and the passenger. In both periods under review we found that, in rather more than 50 per cent of cases, the primary cause of delay was disordered uterine action, while in just under 50 per cent the cause was a mechanical difficulty producing relative disproportion—707 against 584.

Relative Disproportion

Relative disproportion was considered to be present in 584 cases; it was produced by contracted pelvis, a large baby, malpresentation or malposition. Contracted pelvis was not a common finding and accounted for only 50 cases out

of the 584. Its incidence was higher in the second group because of the freer use of X-ray pelvimetry in all suspect cases.

We have been impressed by the frequency with which a large baby (over 8½ pounds or 3·86 Kg.) appeared to be the main factor causing delay. This occurred in a total of 235 cases in the two periods under review, that is nearly 20 per cent, and it was associated with a high foetal loss (20 per cent and 11·5 per cent respectively) in each period.

In the earlier period it was found that just over 35 per cent of this group had a spontaneous vaginal delivery, while in the latter period this fell to 22·5 per cent. At the same time delivery by Caesarean section increased almost 4 times from 4·6 per cent to 16 per cent, whereas the rate of delivery by the forceps remained practically constant in the two periods—51 per cent and 54 per cent respectively. The foetal loss was nearly halved in this group, dropping from 18·9 to 10·3 per cent in the periods reviewed. We are of the opinion that the more frequent and earlier resort to delivery by Caesarean section in the latter period has materially helped to bring about this improvement. When disproportion and abnormal uterine action are both present, disproportion takes priority. It must never be forgotten that disproportion can be an important underlying factor in the production of abnormal uterine action.

Abnormal Uterine Action

Abnormal uterine action was considered to be the primary cause of delay in a total of 707 cases in the 4 years under review. Under this heading we include uterine inertia, incoordinated uterine action and cervical dystocia. Although it is impossible to recognize from the hospital records the incidence of each of these 3 abnormalities, we found that 26·6 per cent of the earlier series and 33·7 per cent of the latter required operative delivery compared to a 64·4 per cent and 77·5 per cent interference rate when relative disproportion was the principal cause of delay. We would point out that the foetal loss is practically the same in both periods in the disordered uterine action group—7·4 per cent and 9·2 per cent, an interesting comparison with the improvement noted in the relative disproportion groups and in spite of a higher rate of delivery by Caesarean section—1 per cent as against 4 per cent.

In comparing the management of uterine inertia in the two periods it is interesting to note that 33 per cent of the earlier cases had stimulation by pituitary extract or thymophysin, while in the latter period only 8 per cent had stimulation by pituitary extract.

Incoordinate uterine action included the colicky uterus and the hypertonic lower segment. Treatment consisted of early, and, when necessary, repeated sedation with morphia, heroin or pethidine. To compare treatment in the two periods under review we decided to classify as heavier than normal sedation more than 1 dose of morphia or heroin or more than 2 doses of pethidine. Hyoscine might or might not have been used. We found that the use of such heavier than normal sedation increased from 8 to 30 per cent in the latter period.

Cervical dystocia is very rarely an organic rigidity due to previous operation or injury. Functional rigidity, in which the cervix partially thins out but fails to dilate in spite of the presenting part being well down, was diagnosed in 6 cases and was treated by cervical incision and delivery by the forceps.

The Time Factor

At the beginning of this paper we mentioned the difficulty of apportioning the true significance of the actual duration of labour in hours. In comparing the two periods under review we found that the number of cases where the labour had lasted over 50 hours fell from 252 to 189. We also noted that the foetal wastage increased as the duration of labour advanced. After 59 hours in labour the foetal loss increased steeply. Below 59 hours the foetal loss was 9 per cent, over it 20 per cent.

Conclusions

(1) Maternal mortality has been greatly reduced in prolonged labour.

(2) Maternal morbidity in cases of prolonged labour, in spite of the use of antibiotics, was 5 times as high as the general rate for the hospital.

(3) The total foetal loss in cases of prolonged labour in 1948–49 was 9·5 per cent, which was only a 3 per cent improvement on the 1940–41 group.

(4) In nearly half the cases of prolonged labour relative disproportion was found to be present.

(5) Better recognition of contracted pelvis is attributed to a more general use of X-ray pelvimetry, which permits of a study of pelvic architecture as well as measurement of diameters.

(6) Much improvement is still required in the management of relative disproportion due to a large baby and in cases of malpresentation and malposition where the labour is prolonged.

(7) More accurate appreciation of foetal anoxia in its earlier stages is necessary. Intact membranes are not necessarily a foetal safeguard. Artificial rupture of the membranes in prolonged labour and gentle easing of the head on each vaginal examination, when assessing progress, may show meconium to be present long before changes are recognized in the foetal heart rate. There is a place for the more frequent resort to Caesarean section in these cases of prolonged labour in the interests of the child. Even if the cervix eventually dilates, the child by then is less able to withstand a vaginal delivery.

(8) The foetal loss in multiparae was much higher than in primigravidae where labour was prolonged. This may be due to the less frequent occurrence of disordered uterine action in multiparae and the greater likelihood of the delay being due to a relative disproportion. The more efficient uterine action and retraction can sooner produce foetal anoxia or cerebral oedema and damage to the respiratory centre.

(9) Earlier resort to Caesarean section is advisable in primigravidae over 30 years of age where a relative disproportion exists.

(10) Provided labour has been diagnosed, once progress as indicated by progressive dilatation of the cervix stops over a period of 8 to 12 hours, the wisdom of further delaying delivery in the hope that progress will again occur is doubtful.

(11) The general factors of age, parity, nutrition, social class and their effect on the general stillbirth and neonatal death rate must be given consideration when assessing a case of prolonged labour. Parity works adversely in this particular group. From a consideration of these factors some idea of the vitality of the foetus can be gauged.

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THE FOETAL PLACENTAL CIRCULATION

Part II—The Gross Anatomy

BY

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IN a previous article (Crawford and Fraser, 1955) it has been pointed out that, by a selective digestion of the placenta with trypsin, it was possible to study the foetal placental circulation in a satisfactory manner. It has also been shown that this study was facilitated by using a simple filler such as gelatine, which had been suitably coloured, to fill the placental vessels. The purpose of this article is to describe the gross features of the placental circulation as they have been observed using this technique.

It is proposed to describe the pattern of the placental circulation under three headings.

First—The Umbilical Cord.

Second—The Foetal Surface of the Placenta, describing arteries and veins separately.

Third—The Maternal Surface of the Placenta.

THE UMBILICAL CORD

The chorionic covering of the cord is relatively resistant to the digestive power of trypsin. At the end of digestion the umbilical vessels are intact and can be catheterized readily with a suitable polythene catheter. Little pressure is required to fill the foetal vessels with the gelatine solution and it is rare for vessels to rupture during the process.

There are usually two arteries and one vein, but a single artery is occasionally found. If two arteries are present they communicate by a very short branch just before the insertion of the cord into the placenta. In many cases this communication is in the nature of an artery to artery anastomosis without any intervening branch. Immediately after this anastomosis the arteries divide into their primary divisions and pass forwards onto the foetal surface of the placenta.

THE FOETAL SURFACE OF THE PLACENTA

The chorion over the foetal surface of the placenta is also resistant to trypsin and, unless excessive digestion has taken place, will be intact, providing a firm framework for the placental vessels. When the placenta is ready for examination it is seen to consist only of umbilical cord, chorion and the vessels with their related cotyledons. The main vessels run between two layers of chorion and are most firmly secured in place. It is necessary to employ sharp dissection to free a main trunk from the chorion.

Each umbilical artery begins to divide before the placenta is reached and the divisions are usually of unequal size. The main trunk divides as a rule into several primary divisions. Two or three of these in each half of the placenta course forward over the chorionic surface. It will be shown later that there are more primary divisions but they cannot as yet be seen.

The fate of each of these primary divisions is subject to variation in individual placentae. It is quite usual for one division to end at once and enter a cotyledon, leaving the other primary divisions to continue their course. These vessels undergo further division into secondary branches. A proportion of these secondary divisions end in cotyledons and leave the remaining divisions to continue towards the periphery of the placenta. Division again takes place and a proportion of the tertiary divisions

will again end in cotyledons. The remainder are now approaching the periphery and a final division into cotyledonary arteries takes place at the limits of the chorion. In other words, at each division of the main vessel a number of the branches plunge immediately through the chorion to end in cotyledons while others continue their course in the chorion towards the periphery. This provides for a roughly concentric distribution of cotyledons.

From the level of the main artery down to the level of the last division lateral branches of varying size, some extremely small, arise directly from the parent vessel and end after an interval in a cotyledon or sub-divide and the sub-divisions end in cotyledons. In general these vessels are much smaller than the main divisions of the umbilical arteries and the size of the corresponding cotyledons is in direct proportion to the vessel.

Two aspects of the arterial circulation are of note. First, in all the placentae examined there was no evidence of collateral circulation, after the primary anastomosis, between the branches derived from the same parent artery or between the branches derived from either umbilical artery. Second, all of the arterial divisions, large or small, ended ultimately in cotyledons. A diligent search has been made for branches which might be concerned in the nutrition of the chorion but these, so far, have not been seen. It is possible that they do exist but were too small for the filler to enter. By the time that the terminal sub-divisions have taken place each half of the chorion is occupied by a network of dividing and sub-dividing vessels and these as already mentioned do not communicate with each other or with the branches in the other half. This is illustrated in Figs. 1 and 2. In some placentae, where one umbilical artery is larger than the other, it may occupy more than half of the chorion with its system of branches.

An arterial branch may enter a cotyledon in one of two ways. The artery may leave the chorion quite suddenly by turning through a right angle, perforating the chorion and passing straight down to the cotyledon. In this variety the artery is joined at the moment of perforation by the accompanying vein and the vessels enter the cotyledon side by side. The chorion accompanies these branches and binds them firmly together.

On the other hand the artery may leave the chorionic surface more gradually and proceed obliquely down to the cotyledon. The vein will join it along this course and the cotyledon is entered by the artery and vein together invested with chorion.

Usually, arterial branches lie superior to veins on the chorionic surface.

The umbilical vein is formed by the union of sub-divisions and divisions of veins much in the same way as the umbilical artery is distributed. The veins in the main accompany the corresponding arterial branches, and the size of the vein matches the artery. Many of the veins show lateral branches which accompany and begin with the small lateral arterial branches already described. These small veins may travel a considerable distance from the accompanying arterial branch before reaching the parent trunk and some of them describe a curved pathway to do so.

None of the veins which were examined show evidence of sphincters. In some of the veins, however, there are constrictions at right angles to their course but these appear to be constrictions by the investing chorion rather than actual sphincters.

The Maternal Surface of the Placenta

In the placental preparation the cotyledons are readily separated from each other and their structure easily examined. They vary greatly in size and complexity and, as previously stated, the calibre of the vessels supplying them is in direct proportion to the size of the individual cotyledon. It will also be seen that quite considerable areas of bare chorion separate the perforating vessels supplying the cotyledons.

The cotyledons are formed in two separate ways. It has already been mentioned that the total number of primary divisions of the umbilical artery is not immediately obvious from scrutiny of the foetal chorionic surface. Subsequent examination of the digested specimen reveals that there are deep branches springing from the under surface of the parent vessels and passing directly through the chorion to form

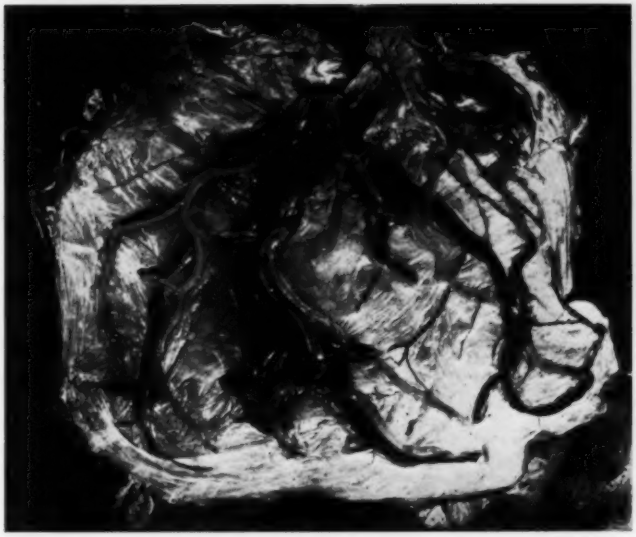

FIG. 1
This shows the foetal aspect of the chorion with the placental vessels ramifying over its surface.

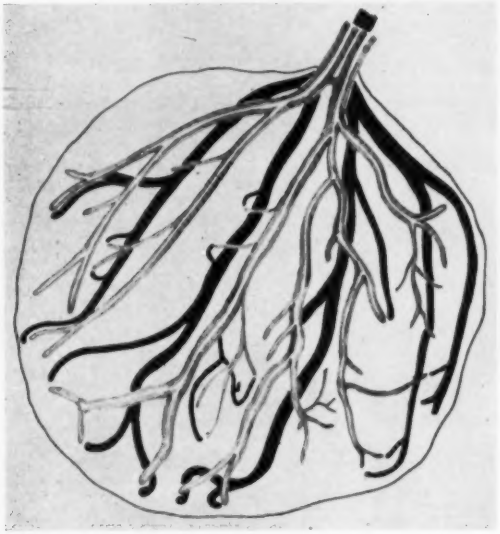

FIG. 2
This is a drawing of the foetal placental surface to illustrate the manner of division and sub-division and the way in which the arteries and veins perforate the chorion.

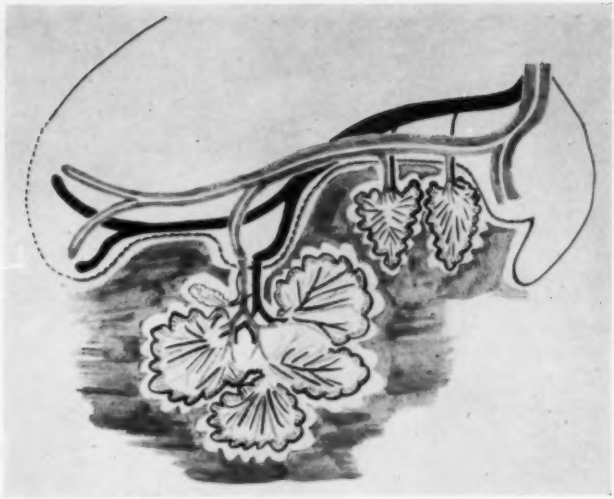

FIG. 3
This drawing illustrates the origin of deep and superficial cotyledonary vessels.

FIG. 4
In this photograph the chorion has been removed to show the manner in which the main vessel-trunks end in cotyledons. The veins lie deep to the arteries and are only occasionally seen. Several cotyledonary arteries can be seen taking origin from the maternal side of the parent artery and passing down deeply at once. A number of smaller cotyledons can be seen taking origin from lateral branches of the main cotyledonary vessels.

J.M.C.

cotyledons. Such deep vessels may arise at the stage of primary or secondary division of the main arteries. They are joined on the way as before by the related vein. Some of these branches may be quite large and themselves constitute primary or secondary divisions.

In the second way the cotyledons are formed by the arterial branches perforating the chorion as already described in company with their veins and entering a cotyledon together. The vessels supplying the largest cotyledons may be of considerable size and sometimes remain intact for 2–3 cm. before branching to form the cotyledon. These variations are demonstrated in Fig. 3.

In the case of the larger vessels division may occur after perforation of the chorion, into two or more branches, usually of unequal size. The method of branching is rather different from that occurring on the chorionic surface. In the latter case branching is in the form of a repeated dichotomy, whereas beneath the surface of the chorion the vessels tend to give off lateral branches while holding to their main course. Both the main stem and these lateral branches give rise to cotyledons, the size varying with the vessel. That supplied by the main stem is usually the largest. Fig. 4 illustrates these points.

The artery and vein supplying a cotyledon have been described as running side by side but occasionally the vein in order to reach the cotyledon may describe a simple spiral over the artery which is running straight or the artery may describe a simple spiral over the vein. This spiral is essentially simple, consisting of one or two turns, and not comparable to the spiralling of endometrial vessels.

In all of the placentae examined there was no evidence of a collateral circulation; each cotyledon has its own separate blood supply.

The Diameter of the Placental Vessels

(1) Arteries:

Primary division ..	0·7 cm.
Secondary division ..	0·5 cm.
Tertiary division ..	0·4 cm.
Cotyledonary vessel	0·2 cm. or less

(2) Veins:

Primary division ..	0·8 cm.
Secondary division ..	0·7 cm.
Tertiary division ..	0·5 cm.
Cotyledonary vessel	0·3 cm. or less

In a subsequent article the structure of the cotyledons will be described.

Discussion

A discussion of the foetal placental circulation necessarily involves consideration of the classical studies of Bumm (1890; 1893) and Spanner (1935). These writers have, with their published work, given us the basic architecture of the placenta and influenced our ideas for many years. Spanner, in particular, gave us his conception of an unidirectional flow of maternal blood within the placenta and today this is still generally accepted. This writer's work was mostly concerned with the utero-placental circulation and the foetal circulation within cotyledons. In 1951, Romney and Reid, on the basis of injection and corrosion studies of some placentae, produced a full and excellent account of the gross foetal placental circulation. These writers were interested principally in the anatomy of the capillary bed but in their investigations produced an apparently clear picture of the foetal circulation. At a later date Wilkin (1954), also using injection and corrosion technique, made observations on the foetal placental circulation.

In this present study the anatomy of the foetal placental circulation differs in several ways from previous published work. The differences are mostly due, it is believed, to the inherent limitations of the injection–corrosion technique which leaves only a cast of the arteries and veins and not the actual vessels. For example, Romney and Reid described a dual arterial supply to a cotyledon at the margin of the placenta. In the digested and injected placenta it is quite clear that a collateral circulation does not occur. It is possible that the disadvantages of the corrosion technique may explain the findings of Romney and Reid. At the periphery of the placenta neighbouring arteries are quite near to each other and spilling of filler could create the artefact of a collateral

circulation. Again, it has been shown in this study that all vessels end ultimately in cotyledons and such a finding is not possible when the placenta has been removed by corrosion because there is no way of checking that all vessels have been filled. The absence of foetal vessels which might be concerned in the nutrition of the placenta has been mentioned. This finding has been commented on by Zeek and Assali (1952) who wonder if the placenta is nourished by the maternal circulation. Spanner described an arrangement about the main vessels resembling vasa vasorum, and indeed in the present placental preparations small vessels can be seen arising from the main vessels. These could conceivably be mistaken for vasa vasorum, but examination of the digested specimen shows that all of them end in cotyledons, often extremely small. The present writer would not care to be dogmatic about this matter; vasa vasorum may well exist and as yet have not been seen.

Romney and Reid and also Wilkin have described spiralling of the vessels to the cotyledons, and a relationship to the coiled arterioles in the ovary and uterus has been suggested. This effect of spiralling has also been noted in the present study but it is a simple spiral of one or two turns involving either artery or vein and is clearly due to the artery or the vein passing the one over the other in order to enter a cotyledon side by side.

In contrast to Spanner, no valve-like structures have been seen in the main venous trunks. The absence of these valves has been commented on previously by Romney and Reid. Constrictions due to the investing chorion have been seen running transversely across the main venous trunks and this could presumably produce the impression of a valve-like structure. Further dissection and histological study may be necessary to confirm this point.

Summary

The gross anatomy of the foetal placental circulation has been described using a digestion and injection technique.

It has been shown that all the vessels derived from either umbilical artery end ultimately in cotyledons and no vessels have been seen which could be concerned in the nutrition of the placenta.

The vessels of the cotyledons have been shown to arise in three ways: firstly, by deep direct branches from the main trunks; secondly, by superficial branches which perforate the chorion; and, thirdly, by branches derived directly from the vessels of the cotyledons.

The absence of true spirals in the vessels of the cotyledons has been commented on and the spirals actually seen having been shown to be of simple type, consisting of one or two turns involving either artery or vein.

Examination of the larger venous tributaries failed to reveal the presence of valves.

It has also been shown that in the placental preparations examined there is no evidence of a collateral circulation at any level from the origin of the primary placental arteries down to the cotyledons.

The anatomy of the cotyledons will be described separately in a subsequent article.

The author would like to express his sincere thanks to Dr. A. D. T. Govan, Director of Research, Research Department, Glasgow Royal Maternity and Women's Hospital, for his help and encouragement in the production of this article; to Mr. A. Fraser for his technical assistance with the placental preparations and photography; to Dr. R. A. Tennant for his encouragement and the opportunity to do this work; to the medical and nursing staff at Bellshill Maternity Hospital for their assistance in the collection of suitable specimens.

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COMMENTS ON ECTOPIC CERVICAL TISSUE IN THE VAGINA

BY

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I READ with a great deal of interest, the recent case report by Tatford (1954) in the *Journal of Obstetrics and Gynaecology of the British Empire* under the title, "Ectopic Cervical Tissue in the Vagina". Bonney and Glendinning (1910), were the first to describe in detail a rare and frequently unrecognized clinical entity, adenomatosis vaginae. Their description of the symptoms, physical findings and microscopic sections are similar to those reported in Tatford's patient. As a matter of fact, Tatford's patient presented the classical and typical picture of adenosis of the vagina, mucus-secreting glands made up of a single layer of columnar epithelium evenly distributed in the walls of the vagina and covered by normal vaginal epithelium, except in those areas, where as a result of complications there is an abnormal communication with the vaginal cavity. The term adenosis of the vagina was coined by Plaut and Dreyfuss (1940), in preference to adenomatosis vaginae which invariably implied tumour formation, which in the light of present day knowledge is not true.

The human vagina is normally devoid of glands and, when these simple mucin-producing glands are detected in the vaginal wall, they are usually referred to as aberrant or ectopic cervical glands, and understandably so, even though they lack the typical branching of cervical glands. Adenosis is thought to be due to an embryological flaw in the development of the vagina. It is now generally accepted that the permanent lining of the vagina is derived from the epithelium of the urogenital sinus and not from the Müllerian epithelium. In the upward growth of the urogenital sinus epithelium, the lateral wall of the vaginal cleft is first occupied, while in the upper midline a tongue of Müllerian epithelium lags and remains for a longer period of time. It is conceivable that, in the event of a developmental abnormality, Müllerian epithelium may remain and at a later date have the ability to differentiate into glandular structures as it normally does in the cervix uteri. This train of events would be a logical explanation for the presence of glandular structures in the walls of the vagina.

Adenosis of the vagina occurs either as a diffuse or circumscribed lesion and is frequently mistaken clinically for a malignant growth; especially is this so in the circumscribed form. The glands do not communicate with the vaginal lumen except as a complication as there are no ducts. The mucin secreted by these glands may, by sheer mechanical force, fracture or macerate the normal overlying epithelium of the vagina and come to communicate with the vaginal canal, producing a copious, glairy and irritating vaginal discharge. When the discharge comes from a circumscribed lesion it is frequently described as apple-jelly-like in appearance. In Figure 1 of Tatford's paper there is a beautifully illustrated example of the vaginal epithelium having been fractured in the upper right corner.

Adenosis of the vagina carries a very important implication in that it supplies a logical anatomical source for the rare primary adenocarcinoma of the vagina, I am presently publishing a paper on this aspect of adenocarcinoma of the vagina supported by an interesting case report.

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VESICAL CALCULUS PRESENTING AT THE CERVICAL OS

BY

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As calculi are rarely found in the uterus or cervix, it is thought that the following case is worthy of record.

CASE REPORT

A Turkish housewife, aged 35 years, attended the Out-patients' Department of this hospital in February, 1954, complaining of a watery vaginal discharge for 3 years. She was a multigravida and apart from her third and ninth pregnancies the others were uneventful. The third infant was delivered at term with forceps in 1944, and during the labour of her ninth and last pregnancy in 1951, the foetus was lying transversely and the labour became obstructed. As she had started this confinement at home, she was eventually brought to this hospital by the local midwife and was delivered of a stillborn foetus by Caesarean section. The patient had an uneventful convalescence until the seventh day of the puerperium when a watery vaginal discharge was first complained of, and on examination a vesico-vaginal fistula was discovered. This was repaired in 1952 with partial success only.

On examination there was a definite discharge of urine from the vagina and on viewing the cervix with a speculum a dark grey tumour was seen occupying the external os. On palpation, the tumour was moderately mobile and the diagnosis of a calculus was made. It was then grasped lightly with ring forceps and removed without difficulty, although in its middle third it was friable and partially disintegrated during the process of removal. The calculus, whose approximate measurements were 2·5 cm. × 1 cm. × 1 cm., was found to have formed round a piece of silk 1·5 cm. in length.

COMMENT

The aetiology of this calculus is, no doubt, to be found in the recurrent attacks of urinary infection in association with urinary stasis in or around the fistula, and in the attempt which had been made to repair this using silk thread. Only three other reports of calculi in the vagina are on record (Youngblood, 1952: Sesbone, 1952; Dexeus and Dalman, 1946). The patient is, at present, awaiting admission for a further attempt at surgical closure of the fistula.

I wish to thank Mr. A. E. Rose for permission to publish this case.

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VAGINAL CALCULUS IN A CHILD

BY

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CALCULUS formation in the vagina has rarely been described. Stansfield, reviewing the literature in 1942, states that his case is the 16th recorded up to that time. Since then I have traced only one other report, by Dexeus and Dalmau (1946). To this series I am adding the following case.

CASE HISTORY

On 26th November, 1949, a child, H.H., aged 7 years, was brought by her mother to the casualty department of Bromley Hospital, complaining of soreness in her vulva and vagina.

Rectal examination suggested a hard object in her vagina. Examination under general anaesthesia revealed a calculus which filled the vagina. It was removed with sponge forceps.

The calculus was of an elongated ovoid shape, about 3 cm. long, of greyish-white colour; the surface was rough and the consistency friable (Fig. 1).

Part of the calculus was broken off and analyzed. It gave a positive test for phosphate with ammonium molybdate–nitric acid; but the tests for uric acid, urates, carbonates and calcium oxalate were all negative.

A catheter urine was clear in appearance, pH 6·5, and contained a trace of albumen. There was no sugar. Cultures did not yield any growth. The centrifuged deposit showed only some amorphous phosphate.

It was learned from the mother that the child had suffered from nocturnal enuresis since birth, but during the last 8 months she had also been incontinent in daytime. The only other previous illnesses had been morbilli, pertussis and varicella.

She was known to be a deep sleeper. She had a twin brother who had also occasional nocturnal enuresis.

The child was subsequently admitted to hospital for investigation of persistent incontinence of urine. Intravenous pyelography and cystography were carried out, but an organic cause of the incontinence was not then discovered.

X-ray films of the lumbo-sacral spine showed lumbarization of the first sacral segment with spina bifida of the first, second and third sacral segments at least. All were congenital abnormalities. The child was subsequently treated medically. There were occasional spells of improvement. On enquiry in March, 1954, she was reported to be still incontinent of urine by day, but dry at night for a week or two at a time and relapsed into diurnal and nocturnal incontinence. Vaginal calculus formation had, however, not recurred up to that date.

On reviewing her condition, it was decided to repeat the investigations. Re-examination of the previous pyelography films led to the discovery of a left duplex kidney. On pelvic examination an ectopic ureter was found to open into the left vaginal fornix. On retrograde pyelography catheters were inserted into the ectopic ureter and, through a cystoscope, into the left vesical ureteric meatus. X-ray showed a rather tortuous, slightly dilated ectopic ureter. The intervening portion could not be traced as far up as the ectopic kidney, but it seemed probable that it belonged to the upper half of the left kidney.

On 26th October, 1954, nephrectomy of the ectopic kidney was performed by Mr. Greening through a left lumbar approach. The ectopic kidney was found to be firmly adherent to the upper pole of the left kidney with its vessels and ureter entering supero-posteriorly.

DISCUSSION

The deliberate or accidental introduction of foreign articles into the various orifices of the body is a frequent occurrence in children. The incidence of foreign bodies in the vagina of children is rare.

In adults, foreign bodies in the vagina other than neglected pessaries and tampons are not infrequently associated with mental deficiency and low intelligence.

Deliberate introduction of foreign bodies by the child probably only occurs in cases where the child's curiosity has been roused and the hymen is deficient or the introitus relatively open.

Owing to the rarity of their occurrence, cases have usually been reported and perusal of the medical literature of the last 20 years shows an astonishing variety of objects, sufficient to constitute a museum: safety pins, fruit, hair pins, pieces of paper, stones, pieces of cotton, cotton wool, various cylindrical objects and, in adults, forgotten tampons, pessaries, contraceptive appliances, a smoking pipe and even a piece of

1 Pl.

ligamentum nuchae of an ox introduced by an irate husband (Hoge, 1946)!

Aetiology of Vaginal Calculus Formation

The presence of calculi in the vagina may be primary or secondary. The former seems to be very rare. From review of the known cases, Stansfield (1942) postulates the following aetiological factors: The presence of a "congenital or acquired vaginal stricture and urinary leakage into the vagina through a fistula or as a result of urinary incontinence". The case of Dexeus and Dalmau (1946) fits in well with this explanation: traumatic amputation of the lower third of the urethra with subsequent cicatricial occlusion of the vaginal introitus resulted in the vagina acting as a reservoir from which urine leaked slowly, but continuously, after micturition. A calculus then formed in the vagina.

Excepting cases of urinary fistulae, calculus formation in the vagina is probably always secondary to the presence of a foreign body.

Calculus formation as a concretion around a foreign body was reported by Everke (1926): a smoking pipe had caused pressure necrosis of the anterior vaginal wall and vesico-vaginal fistula.

In Esau's case (1932) a vesical calculus caused decubitus ulceration into the vagina and secondary formation of calculus in the vagina.

Silk ligatures in the anterior vaginal fornix had led to vesical fistula formation in Hirschberg's case (1914). The ligatures had become encrusted with urinary salts, forming vaginal calculi.

In Canigliani and Mayer's case (1935), cotton wool fibres were found to form part of the calculus. In the case of an alleged primary calculus reported by Kriss (1933), it was admitted that the patient had refused permission for the main calculus to be analyzed.

The case reported by McCullagh (1939) in a female of 38 years was regarded by the author to be secondary to formation in urethral diverticula.

The case of Lamy and Taby (1939) in a woman of 61 years was secondary to vesical calculus and vesico-vaginal fistula, following total hysterectomy for fibroids 14 years previously.

In Halban's case (1900), calculi formed in a cystocele. Bortkjewitsch (1912) reported calculi consisting of phleboliths situated in the venous plexuses along the lateral parts of the posterior vaginal wall.

It is claimed by some workers that the nucleus around which concretions may gradually form a calculus may at times be very small, as in the case of Canigliani and Mayer.

With regard to the chemical composition, the calculus reported consisted of phosphate, similar to that of Canigliani and Mayer. Phosphate was also found on analysis of the child's urine, but not in the case of Canigliani and Mayer. The calculus reported by Lamy and Taby (1939) consisted of urates only.

Clinical Features

The predominant symptoms due to foreign bodies in the vagina may be pain, bleeding or vaginal discharge.

Pain. This was the symptom causing the child to be referred for treatment. In the series of 7 cases of foreign bodies in the immature vagina, reported by Hepp and Everhart (1950), pain was a symptom of equal importance to bleeding.

Vaginal bleeding. This is commonly regarded as pathognomonic of foreign bodies in the immature vagina (Schauffler, 1939), but may be due to trauma or malignant neoplasm. Usually this symptom leads to prompt investigation and diagnosis.

Absence of bleeding should never be allowed to exclude the possible diagnosis of a foreign body in a child.

Vaginal discharge. It is noteworthy that this was absent in the case described. It seems to be the most constant symptom in the cases reported in the literature. The discharge is mostly purulent and often offensive.

Children are frequently referred for a gynaecological opinion on account of vaginal discharge. Although this is sometimes due to excessive cervical secretion associated with a congenital cervical erosion, foreign bodies should always be suspected, as symptomatic treatment is bound to fail if the presence of a foreign body is overlooked. This may not always be a palpable object on rectal examination. A few wisps of cotton wool (particularly in

FIG. 1
Vaginal Calculus.

children with enuresis where cotton wool may be used to keep them dry), or fluff from coloured shorts worn by schoolgirls, may be sufficient to set up a vaginal discharge.

As a satisfactory examination cannot often, and perhaps should not, be carried out without general anaesthesia, there will be a tendency to take swabs for bacteriological examination (which incidentally may leave bits of cotton wool behind; therefore a pipette is preferable) and if these are reported to be "negative", one may be inclined to reassure the mother, feeling unjustified in subjecting the child to the risk of an anaesthetic, however small it may be. Rectal examination can often be carried out in children and in a few cases, such as the one reported, the presence of a foreign body can be diagnosed.

But if it is felt that any form of vaginal or rectal examination in the conscious child is unsatisfactory, inaccurate and psychologically inadvisable, examination under anaesthesia should be used and often the treatment can be carried out at the same time.

Schauffler (1939) advises examination with a urethroscope; Clauberg (1935) recommends a fine cystoscope; Oswald Lloyd uses an infant laryngoscope.

Summary

A case of vaginal calculus in a child suffering from urinary incontinence due to an ectopic ureter has been described. The aetiology, clinical features and investigation of foreign bodies in the immature vagina have been discussed.

I wish to thank Mr. Oswald Lloyd for helpful criticism, and Mr. W. P. Greening, Dr. J. N. O'Reilly and Dr. Maurice Woods for permission to publish the case.

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THE AGE OF ONSET OF GENITAL TUBERCULOSIS IN WOMEN*

BY

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GENITAL tuberculosis in women is a notoriously silent condition and it is not infrequently found by chance in an operation specimen removed for some unconnected lesion. Most cases are diagnosed in the third and fourth decades (Greenberg, 1921; Jedberg, 1950; Haines, 1952) but this must not be confused with the usual age of onset. For instance, Jedberg considers that genital tuberculosis in women develops "within the first year of the initial manifestation of tuberculosis and even within 1 year of tuberculous infection". As genital tuberculosis is almost always secondary to some other focus it is reasonable to expect that it is usually established at or before the second or third decades, the period of greatest mortality from tuberculosis in women (Rich, 1951, p. 220). In this study I have attempted to establish or refute this hypothesis by an analysis of the clinical data of women in whom a diagnosis of genital tuberculosis was established histologically.

MATERIAL AND METHODS

A survey was made of the 201 cases of genital tuberculosis diagnosed in the laboratory of St. Mary's Hospitals, Manchester, between 1921 and 1954. Adequate clinical notes were available on 64 cases and the following points were abstracted: (1) the years since a last pregnancy if any, (2) duration of present complaint, (3) history of extragenital tuberculosis, (4) a history of "appendicitis". The findings are summarized in the table (Table I). Using these data the age of onset has been estimated as far as possible. Certain general principles have been followed when making these estimates. For instance, I have taken a history of involuntary primary sterility in a married woman as evidence of genital tuberculosis for at least the duration of her married life. If there is also a history of active extragenital tuberculosis a few years before marriage I consider that there is strong presumptive evidence that the genital infection dated from the period of activity of the extragenital lesion, for blood-stream dissemination is more likely then than during a period of quiescence. A history of sterility is of less value when no such complaint has been made and when no data on the use of contraceptive methods are given; and only in 1 case was absence of husband on war service noted.

TABLE I

List of Chief Complaints and Findings of 64 Cases of Genital Tuberculosis

Sterile (women married more than 2 years)	42
Complaint of sterility	18
Abdominal pain	24
Extragenital tuberculosis	24
"Appendicitis"	10
Primary amenorrhoea	2
Secondary amenorrhoea	10
Menorrhagia	8
Vaginal discharge	2

Illustrative case. A nulliparous woman of 26, married 6 years, complained of left-sided abdominal pain and vaginal discharge for 3 years. No complaint of sterility was made. She had had an abscess in the neck at the age of 13.

Conclusion. The pelvic symptoms suggest that the genital tuberculosis had been present for at least 3 years, the sterility suggests that it may have been present for 6 years and the cervical abscess 13 years ago may have been the extragenital focus of dissemination. The probable age of onset was recorded as 13.

Genital tuberculosis is so well recognized as a cause of sterility that in the majority of patients in this series genital tuberculosis was probably the operative factor even if no complaint of

* Part of a thesis accepted for the degree of M.D. of the University of Cambridge.

sterility was made; 82 per cent of those married 2 years or more were sterile (see Table I) against 17 per cent of a comparable control series of 71 women from whom operation specimens had been received in the laboratory. I have chosen the arbitrary period of 2 years' childlessness after marriage as my basis of sterility in this survey. It is realized that 2 years as a diagnostic standard may be too short for couples involuntarily separated or practising contraception and too long for couples who desire to have a family as soon as possible.

In parous women it seems reasonable to assume that the genital infection often resulted from a flare-up of tuberculosis after the last pregnancy; this is not to say that each flare-up of tuberculosis after a pregnancy will result in genital tuberculosis.

Illustrative case. A woman of 31, married 6 years with a pregnancy 4 years ago, complained of right-sided abdominal pain for 2 years. Appendicectomy had been performed 2 years ago. Dense pelvic adhesions were found at salpingectomy.

Conclusion. Genital tuberculosis had been present for at least 2 years; it probably developed as the result of a flare-up of an extragenital focus at the time of her pregnancy.

Phillips (1922) suggests that marriage may aggravate a dormant genital tuberculosis. The following may be an example.

Illustrative case. A nulliparous woman of 26, married 2½ years, complained of a vaginal discharge for 2 years but no complaint of sterility was made. She had been in a sanatorium at the age of 22.

Conclusion. Genital tuberculosis was probably established at the age of 22 but remained symptomless until after marriage when the dormant focus was lighted up.

The duration of the present complaint is not a reliable index of the duration of the lesion, for genital tuberculosis is often silent and the symptoms may be due to some coincidental gynaecological lesion. However, the evidence is of some use, especially in estimating a minimum duration of the genital tuberculosis.

A history of "appendicitis" is of value as an indication of right-sided lower abdominal pain which, in at least some cases, was probably referable to the Fallopian tubes. It has, therefore, some value as corroborative evidence.

Illustrative case. A nulliparous woman of 24, married 3 years, complained of a brown vaginal discharge for 7 years; she had had symptoms of tabes mesenterica at an unstated age, and an appendicectomy with peritonitis at the age of 15.

Conclusion. Genital tuberculosis had almost certainly been present for 3 years and probably for 7. The history of appendicectomy was not considered to be sufficient evidence to warrant a conclusion that genital tuberculosis was present 9 years ago. However, if it were known that the symptoms of tabes mesenterica had occurred before the symptoms of appendicitis I would consider it as probable that the symptoms were those of tuberculous salpingitis rather than of appendicitis.

Protocols of the 64 cases analyzed are given elsewhere (Burne, 1954).

Results

The average age at diagnosis was 31·3 and the age of onset 22·9, giving on average a lag of 8·4 years, the deviation from this mean being a few weeks to 21 years. The peak age of onset occurred in the first half of the third decade (see Fig. 1).

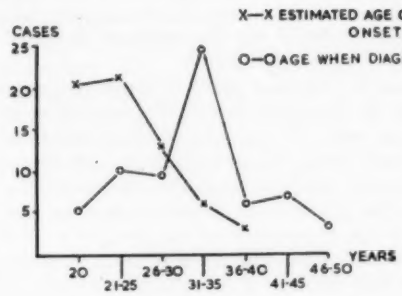

FIG. 1
Age Incidence of Genital Tuberculosis.

This corresponds closely with the recognized peak period of active tuberculosis in women as reflected by the mass radiography returns published in the report of the Ministry of Health (1952). I consider it reasonable to assume that at this period the incidence of blood dissemination will be high and that there is good theoretical support for my estimated age of onset.

Four groups can be identified:

(1) Childhood infections.
(2) Those symptomatic from the onset of the genital tuberculosis and with little delay in diagnosis.
(3) Those in whom symptoms are slight with consequent delay in diagnosis.

(4) Those in whom the tuberculous lesion is an incidental finding at operation for some other condition.

Group 1. There were 2 examples of childhood infections, both patients having cryptomenorrhoea and haematometra. One was a single girl of 19 and the other a married woman of 29.

Group 2. Thirteen cases were placed in this group, 2 years being arbitrarily chosen as the maximum estimated delay in diagnosis for the group. The average age at operation was 23·4 and the age range 17–40, only 4 patients being over 25. The lesion is typically an active one in young women and co-existent active extra-genital foci are more likely than in the other groups.

Illustrative case. A single girl of 19 was admitted with anaemia, amenorrhoea, vaginal discharge and epigastric pain of 3-months duration. At operation tuberculous peritonitis was found and caseating Fallopian tubes removed.

Conclusion. The genital tuberculosis had probably been present for less than 1 year. The history and findings do not suggest a childhood infection.

Group 3. The third group is the largest, consisting of 43 women who were symptomless or who had relatively minor and often ill-defined symptoms which they were able to tolerate for many years, sterility being often the reason for which they presented themselves at hospital. The average age at diagnosis of this group was 31·8 and the mean estimated age of onset 22·8, giving an average time lag of 9 years, with a range of from 2 to 21 years.

Illustrative case. A nulliparous woman of 28, married for 6 years and desiring children, was admitted complaining of 4-months amenorrhoea followed by haemorrhage. She had been under observation 11 years previously for tuberculous peritonitis. Salpingo-oöphorectomy was performed and a non-caseating tuberculous salpingitis found.

Conclusion. Tuberculous salpingitis had probably been present since the peritonitis 11 years previously. The history of sterility is supporting evidence that it had been present at least 6 years. Presumably the infection flared up 4 months before operation.

Group 4. This group consists of 6 women between the ages of 40 and 46; the presenting symptoms were probably those of some other lesions such as fibroids or menopausal disorder. The estimated mean age of onset is 27·8.

Illustrative case. A nulliparous woman of 45, married 23 years, was admitted complaining of menorrhagia for months. She said that she and her husband had never used contraceptives and had always wanted children. There was a palpable abdominal mass. At operation a bilateral tuberculous pyosalpinx and uterine fibroids were found.

Conclusion. Tuberculous salpingitis had been present for at least 23 years and was a chance finding.

Discussion

The difficulties in arriving at an accurate assessment of the age of onset of genital tuberculosis must not be minimized and in individual cases the estimated age may not be very accurate, but I have endeavoured to reduce these to a minimum by excluding cases in which evidence is scanty. In particular it is likely that children under about 5 years of age form a group whose importance is not fully brought out in this series. Rich (1951, p. 182) stresses the high mortality under 5 and especially in the first year of life, the period between 5 and puberty being a strikingly "safe" one, after which the death hazard increases sharply. It would be surprising if the incidence of genital tuberculosis did not reflect the earlier of these peaks, as I consider it does the second. The genitalia of infants and adolescents are, of course, not strictly comparable for at birth they are pre-pubertal and non-functioning in contrast to their state in adolescence; presumably the blood supply, and so the opportunity for blood-borne metastasis, is greater in the adolescent organs; the increased blood-supply results in increased oxygen supply thus further favouring the establishment of tubercles (Rich, 1951, p. 323). The influence of sex hormones on tuberculous infection is still uncertain but experiments have so far failed to yield conclusive evidence that they have any effect upon it. The experiments, however, cannot be regarded as evidence against a complex hormonal activity since for the most part they were confined to the injection of a single hormone (Rich, 1951, p. 239).

There appear to be no adequate data on the incidence of genital tuberculosis in childhood. Still (1901) in a survey of 126 consecutive autopsies on girls under 12 who died of tuberculosis found that 9·5 per cent had macroscopic evidence of genital tuberculosis. His youngest case was a girl of 8½ months. Phillips (1922) discusses the sequelae of genital tuberculosis in

childhood and refers to 5 cases of his own. He considers that certain gynaecological complaints, primary amenorrhoea, dysmenorrhoea, dyspareunia and sterility may be due to damage done to the genital organs by tuberculous disease before the organs are fully developed. Dougal (1931), in a study of 10 women with primary amenorrhoea caused by obstructive inflammatory lesions of the uterus, considered that at least 6 of the cases were tuberculous; probably in the past the majority of such cases have died in childhood and the genital lesion has been overlooked. Now that streptomycin and other drugs save the lives of many of these children it may be that when they come to marry some, if not many, will prove to be sterile because of an unsuspected genital tuberculosis in childhood. One can only hope that the treatment that has saved so many young lives will also have saved their generative organs from irreversible damage. The occurrence of genital tuberculosis in childhood seems to have been lost sight of somewhat in recent years and Jedberg, writing in 1950, considers that genital tuberculosis practically always occurs during the fertile age. It may be, of course, that with the decline in incidence and severity of tuberculosis the genital form in childhood has almost disappeared. Nevertheless, a careful study of the available data may, in more people than is realized, indicate a childhood infection which has lain dormant until disclosed by marriage or a flare-up during adolescence.

Onset after puberty. It is desirable that no case should go undiagnosed because it is silent, for early treatment by modern drugs may prevent sterility. Jedberg (1950) found that 3 out of 100 sanatorium patients had silent genital tuberculosis. This contrasts with the series of Cameron (1951) in which no special effort was made to detect genital lesions; out of about 1,500 women of childbearing age discharged from sanatoria only 8 (0·5 per cent) were known cases of pelvic tuberculosis. It is debatable whether, because of such cases, routine gynaecological investigations should be carried out in sanatoria; however, any suggestion of a gynaecological disorder would seem to warrant a careful investigation including histological examination of the endometrium and guinea-pig inoculation for tubercle bacilli.

Summary

The difference between the age at diagnosis and the age of onset of genital tuberculosis was estimated in 64 cases in which adequate clinical data were available. The average age at diagnosis was 31·3 and the age of onset 22·9 giving on average a lag of 8·4 years between the 2 events; the deviation from this mean age is very great (a few weeks to 21 years). That most infections are estimated to have begun under the age of 25 means that infection usually occurred at an age when active tuberculosis is commonest in women and blood dissemination of bacilli most likely. The cases fall roughly into 4 classes: childhood infections, those diagnosed soon after onset because of the general severity of the condition; those presenting after a lapse of years, either with chronic symptoms or because of sterility; and those found by chance in later life at a pelvic operation for a coexistent gynaecological condition.

Genital tuberculosis in children may be commoner than realized and may result in permanent damage to the organs. It is possible that such changes may be present in the genital tract of girls cured of severe tuberculous infections by modern chemotherapeutic methods.

The incidence of unsuspected genital tuberculosis in sanatorium patients is briefly discussed.

Acknowledgments

I am indebted to the consultant staff of St. Mary's Hospitals, Manchester, for the clinical data and to Professors A. C. P. Campbell and W. I. C. Morris for advice and criticism.

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ELECTROPHORETIC ANALYSIS OF SERUM PROTEINS IN PREGNANCY

II—Effect of Labour and Lactation

BY

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AN analysis of the various serum protein fractions in the antenatal stages of pregnancy has been presented in a previous communication (Brown, 1954). This present paper deals with the effects of labour and of the establishment of lactation on the serum proteins and, as before, the analysis is effected by electrophoresis. This article completes a study of the behaviour of the proteins of the blood throughout the various stages of pregnancy, delivery, and the puerperium in normal subjects. Normal standards present a yardstick against which we may measure the effects of pathological states and it is necessary to extend our previous communication to deal with the terminal stages of pregnancy.

EFFECT OF PARTURITION IN NORMAL PREGNANCY ON SERUM PROTEIN FRACTIONS

Following delivery there is frequently a dramatic clinical improvement in patients suffering from various complications of the antenatal period. This is particularly apparent in toxaemic states. This clinical improvement may be associated with changes in serum protein values and, if so, it may be possible to correlate these changes with the improvement in signs and symptoms. Interpretation, however, is difficult, if not impossible, unless standard values are obtained for this period. Many cases show immediate improvement within 24 hours of confinement, but in others the improvement is more gradual and takes place over a period of some days. It was therefore considered necessary to study the serum proteins on several occasions during this period. As a first step towards this it was decided to analyze the serum proteins before and after labour in a chosen group of patients. Patients were chosen carefully from the point of view of normality. All had remained normal throughout their antenatal periods. There had been no albuminuria, rise of blood pressure or evidence of oedema in this series. The haemoglobin levels had remained within normal limits and the labours, occurring at the expected date of delivery (or within 7 days of that date), had terminated in spontaneous vertex deliveries within 24 hours.

Serum was obtained from a large number of normal patients at term and, from these, 8 have been chosen in whom labour commenced within 12 hours of obtaining the specimen. A further specimen from each of the chosen normal cases was obtained 24 hours after confinement. The sera, taken before and after confinement, were subjected to the technique of analysis described previously (Brown, 1954).

Results

The results obtained from the sera taken before labour appear in Table I. The results from sera of the same patients after labour appear in Table II. In Table III for comparison are reproduced the average values for serum protein fractions of sera taken from 10 normal pregnancies in the 3 trimesters of pregnancy.

On comparing the tables of results it will be noted that there is little change in the average total protein values during the third trimester (6·48 g./100 ml.) and just before labour (6·417 g./100 ml.). There is, however, a definite fall in the albumin/globulin ratio from 0·8 to 0·69. This is due, on further inspection of the tables, partly

TABLE I

Values of Protein Fractions Obtained by Electrophoretic Analysis of Sera from 8 Normal Pregnancy Cases before Labour

Values of Fractions are Recorded in g./100 ml.

Serum	Albumin	α_1	α_2	β	γ	Total Protein
1	2·96	·339	1·575	1·502	·884	7·26
2	1·83	·85	1·54	·85	·99	6·06
3	2·85	·23	1·09	1·32	·53	6·02
4	1·88	·27	·94	1·86	1·2	6·15
5	2·5	·35	·8	1·09	1·13	5·87
6	3·576	·423	·761	1·128	·804	6·692
7	2·529	·529	1·66	1·504	·765	6·987
8	2·76	·345	·843	1·233	1·119	6·3
Totals	20·885	3·336	9·209	10·487	7·422	51·339
Averages	2·61	·417	1·151	1·311	·927	6·417

Average Total Globulin = 3·806 g./100 ml.
Albumin/Globulin ratio = 0·69

TABLE II

Values of Protein Fractions Obtained by Electrophoretic Analysis of Sera from 8 Normal Pregnancy Cases after Labour

Values of Fractions are Recorded in g./100 ml.

Serum	Albumin	α_1	α_2	β	γ	Total Protein
1	2·67	·52	·91	1·5	1·08	6·68
2	2·15	·4	1·42	1·55	1·28	6·8
3	2·42	·32	·9	1·29	1·16	6·09
4	2·25	·345	·88	1·67	1·315	6·46
5	2·9	·3	·8	1·34	1·91	7·25
6	3·23	·41	·87	1·31	1·02	6·84
7	2·45	·44	1·48	1·59	1·03	6·99
8	2·17	·4	·99	1·56	·93	6·05
Totals	20·24	3·135	8·25	11·81	9·725	53·16
Averages	2·53	·392	1·031	1·476	1·216	6·645

Average Total Globulin = 4·115 g./100 ml.
Albumin/Globulin Ratio = ·615

to a fall in albumin but there is also a rise in total globulin and mainly in the γ fraction which increases by 0·269 g./100 ml. A slight increase (0·118 g.) also takes place in the α_2 fraction, and α_1 moiety decreases slightly (0·175 g.) while the β complex is practically static. Twenty-four hours following labour (Table II) the total protein concentration of the serum rises slightly, from a level of 6·4 g. before labour to 6·6 g./100 ml. but the albumin/globulin ratio shows a further fall, from 0·69 to a value of 0·61. Albumin is decreased from 2·61 to 2·53 g./100 ml. while the globulin is increased by 0·309 g./100 ml. The main change noted in the globulin complex occurs, once more, in the γ fraction which increases from 0·927 to 1·216 g./100 ml. A slight rise in the β fraction occurs but the α_2, increased just before labour, returns to its third trimester value. The α_1 factor continues to show a slight fall amounting to 0·025 g.

To summarize, albumin continues to fall up to and for 24 hours after confinement; total globulin increases progressively during the same period. This increase of globulin, like the fall in albumin, occurs progressively throughout pregnancy. The rise during labour and the early part of the puerperium is due to an entirely different fraction from that causing the increase during the antenatal period. Throughout pregnancy the globulin increase is due mainly to the β fraction (gaining 0·351 g. from first to third trimesters) and the α_2 fraction (gaining 0·411 g.). During labour and the early puerperium the β fraction gains 0·165 g. and the α_2 loses 0·12 g. almost cancelling each other out whereas the γ fraction, which in the antenatal period shows a constant fall, increases by 0·289 g. The main changes in these constituents are shown graphically in Figs. 1 and 2.

TABLE III

	Total serum Protein	Albumin	Total Globulin	α_1	α_2	β	γ	Albumin/ Globulin Ratio
Non-pregnant .. 1st trimester	7·1	4·186	2·89	·358	·689	·995	·848	1·5
Average of 10 sera 2nd trimester	7·317	4·328	2·989	·551	·622	·964	·852	1·4
Average of 10 sera 3rd trimester	6·828	3·762	3·066	·523	·757	1·027	·759	1·2
Average of 10 sera	6·48	2·882	3·598	·592	1·033	1·315	·658	·8

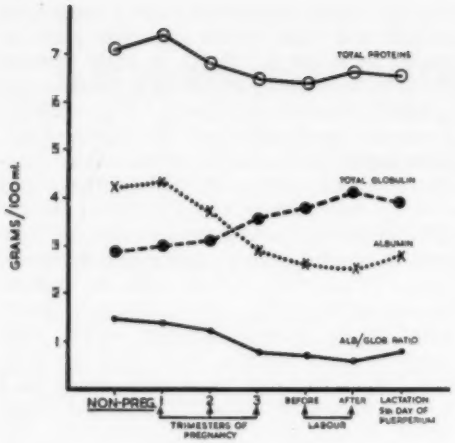

FIG. 1

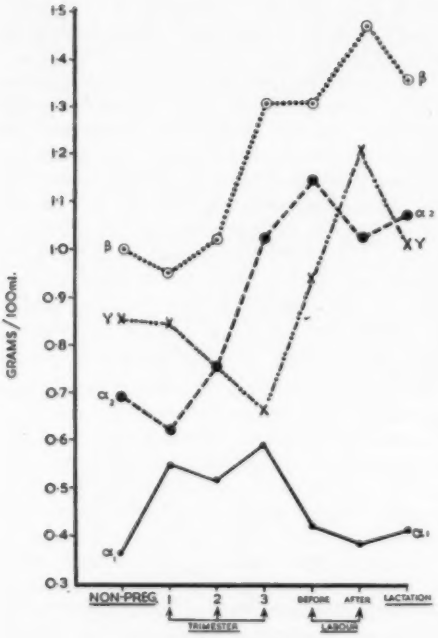

FIG. 2

Commentary

The values for total serum proteins do not appear to change during the last trimester of pregnancy. Before labour the total concentration is almost exactly the same as that found in a series of patients studied in the earlier part of this trimester. There are, however, changes in the values of certain fractions and the relationship of the main fractions. The albumin, which shows a fall during the antenatal trimesters, continues to diminish, whereas the globulin shows a further increase thus resulting in a further fall in the albumin/globulin ratio. The increase in globulin, however, previously due to increases in α_2 and β fractions, is now mainly caused by a rise in the γ factor. Following confinement, the total protein is increased but the reversal of the main component values is even more marked and the albumin/globulin ratio is further diminished. The fall in albumin and rise in globulin continue. The increase in the globulin is once more mainly due to the rise in the γ factor.

While these changes may be of primary nature there is the possibility that they are secondary to events occurring at this time. During any obstetric delivery there is always a certain amount of unavoidable blood loss. In addition there are said to be changes in blood volume, probably in part of a compensatory nature due to the haemorrhage. Around this time, too, there is an active secretion of colostrum which has a relatively high protein content (2·0–2·6 g. per cent according to Holt, Courtney and Fales, 1915). If these changes were due to blood loss or readjustment of blood volume alone, one would expect any change in serum protein concentration to be reflected equally in the various protein fractions. It has been shown that such is not the case. There is a quite distinct change in the pattern of these fractions which can only be explained on the basis of a more vital mechanism.

The possibility that these changes may be related to the mammary secretion must be considered and this has been done in the following section.

SERUM PROTEIN VALUES IN ESTABLISHED LACTATION

According to Holt, Courtney and Fales (1915) human milk contains a considerable amount of

protein. During the period with which we are dealing two types of breast secretion occur. Colostrum is secreted in the first few days of the puerperium and thereafter true milk secretion is established. Holt and his colleagues found that colostrum contains 2·0–2·6 g. per cent, and that true milk contains 1·1–2·0 g. per cent of protein. This loss of protein may well influence the level of serum proteins of the patient and it must be taken into consideration when comparing normal and abnormal patients. In addition, it has already been noted that many cases of toxaemia show a gradual improvement in symptoms and signs during the puerperium and it is necessary to obtain figures for the normal mid-puerperium for comparison. It was felt that both these studies could be combined by analyzing sera from normal patients in whom lactation was established. For this purpose it was decided to study sera from normal patients on the fifth day of the puerperium. Only patients who had been considered normal, from a clinical viewpoint, before and throughout delivery and thereafter, were included in this series. In each case lactation was properly established.

Specimens of serum were obtained from 10 patients who fulfilled the requirements already stated. The sera were subjected to electrophoretic analysis by the technique previously described.

The results of analysis with values for each fraction of the protein complex, and the albumin/globulin ratio, appear in Table IV. These may be compared with values for serum proteins before and after labour shown in Tables I and II.

Reference to the results shows that the average total serum protein value for the lactation sera of 6·62 g. does not differ greatly from the value of 6·65 g. per cent found 24 hours after labour. The albumin value of 2·79 g. has risen slightly from a level of 2·53 g. per cent in patients after labour. The total globulin value of 3·828 g. is lower than that of 4·12 g. per cent after labour.

The gain in albumin from the early to mid-puerperium values (0·26 g.) and the fall in total globulin (0·29 g.) is reflected in the albumin/globulin ratio, which rises from 0·61 to 0·73. This rise in albumin/globulin ratio reverses the fall which has continued since the early months of pregnancy.

TABLE IV

Lactation Series

Results of Protein Analysis of 10 Sera from Normal Patients with Established Lactation

	Albumin	α_1	α_2	β	γ	Total Protein
1	2·78	·36	1·24	1·84	0·67	6·89
2	2·81	·41	1·22	1·22	·74	6·4
3	2·38	·42	1·08	1·39	·93	6·2
4	2·43	·45	1·49	1·39	1·22	6·98
5	3·07	·3	·7	1·49	1·14	6·7
6	2·45	·42	1·31	1·07	1·34	6·58
7	3·12	·44	·57	1·25	1·06	6·44
8	3·36	·4	1·11	1·0	·83	6·7
9	2·7	·52	1·18	1·12	·54	6·06
10	2·81	·4	·76	1·68	1·6	7·25
	27·91	4·12	10·66	13·45	10·07	66·2
	2·79	·41	1·066	1·345	1·007	6·62

Total Globulin (from average) = 3·828
Albumin/Globulin ratio = 0·73

The globulin fractions show a very slight change in the α_1 and α_2 moieties which increase by 0·02 g. and 0·04 g. from their values in the early puerperium. The β and γ fractions both decrease more markedly, by 0·13 g. and 0·21 g. respectively and are therefore mainly responsible for the fall in amount of total globulin (Table V).

TABLE V

	Before Labour	After Labour	5th day of Puerperium: Lactation established	
Total serum proteins ..	6·42	6·65	6·62	g./100 ml.
Albumin	2·61	2·53	2·79	"
Total globulin ..	3·81	4·12	3·83	"
Globulin fractions:				
α_1	·42	·39	·41	"
α_2	1·15	1·03	1·07	"
β	1·31	1·48	1·35	"
γ	·93	1·22	1·01	"
Albumin/ Globulin ratio	0·69	0·61	0·73	"

Commentary

The total protein value appears to remain fairly static following labour and shows but little difference from that found before labour. It is,

however, slightly higher than before labour having appreciated by 3·1 per cent over the prelabour value. This slight increase in total serum protein does very little to restore its value to that found in the early months of pregnancy (7·32 g. per cent) from which it has fallen by almost 9·6 per cent. The rise in total serum protein occurring after labour, however, is worth noting since it is the first time that the progressive fall operative since early pregnancy has been reversed. The albumin value, like the total protein value, increases over the level found before labour but differs from the behaviour of total protein, in that it falls very slightly during labour. At the fifth day of the puerperium the serum albumin has gained 7 per cent from the level found before labour but is still below the average value of 4·33 g. per cent in the early months of pregnancy.

Serum globulin, which continued its antepartum progressive increase until after labour, appears to fall when lactation is established. The average value found at this time is, however, 28 per cent above that found in the first 3 months of pregnancy.

The albumin/globulin ratio of 0·73 has risen, like serum albumin, from its value of 0·61 after labour. The behaviour of the main constituents of the serum protein thus far can best be appreciated by graphic representation. Fig. 1 shows the concentrations of total protein, albumin, globulin and the varying values of the albumin/globulin ratio throughout pregnancy, before and after labour, and on the fifth day of the puerperium.

The variations in the total serum protein value are almost paralleled by the changes in the serum albumin and in the albumin/globulin ratio, which one might expect. The levels of serum albumin and globulin seem to follow inverse tendencies.

The fall in globulin from the level found after labour is mainly due to the β and γ fractions which appear to decrease when lactation is established. The β fraction value appeared to change little during the later months of pregnancy, to rise during labour, and then to fall to a level almost exactly like that found before labour started. The γ fraction which increased progressively from the third trimester of pregnancy after an initial fall in the early months, diminished in value following labour. It is obvious that during the puerperium there is a trend towards the establishment of the normal non-pregnant values. Fig. 2 illustrates, in graphic form, the behaviour of the fractions of the globulin complex from early pregnancy until lactation is established.

Reference to Fig. 2 emphasizes the fact that changes in the volume of circulating blood, whether associated with the physiological haemo-dilution of the ante-partum stages of pregnancy, incidental to the normal blood loss of parturition, or compensatory thereto, cannot adequately explain the variations in amount of the serum protein fractions which vary in diverse fashion. It is interesting to note that, apart from a rise in total protein mainly related to serum albumin and a consequent rise in albumin/globulin ratio, lactation has no particular effect on the level of the serum proteins. Serum albumin level alone has risen. All fractions of the serum proteins have been subjected to the various volume losses and readjustments incidental to labour, but the albumin moiety is the only one which shows a positive change.

Summary of Changes Occurring in the Serum Proteins throughout Normal Pregnancy and the Puerperium

From results obtained in the previous sections the changes occurring in the values of the various serum protein fractions may be reviewed.

In our series the total serum protein level in the non-pregnant subject has an average value of 7·1 g. per cent. This figure is exactly the same as that quoted by Dieckmann (1952) and is in agreement with reports by other authors such as Bradshaw (1950). As pregnancy advances in its first trimester there is little significant change in the total protein content of the serum but there is a diminution in the middle trimester of pregnancy and this fall continues until labour is over. Following labour there is little change in the total serum protein level which remains fairly constant until true lactation is established. From the non-pregnant state to term the total serum protein level is diminished by 9·8 per cent. When lactation is established the serum protein

level rises but the mid-puerperium still shows a decrease of 6·8 per cent compared with the non-pregnant level. The serum albumin value falls from the early months of pregnancy until labour is over and then rises slightly, decreasing over all by 33·6 per cent of its non-pregnancy level. The total serum globulin follows an inverse pattern of values and when lactation is established it has increased, compared with its value in the non-pregnant female, by 32 per cent.

The reversal of values of serum albumin and globulin which is found on the fifth day of the puerperium results in a considerable change in the albumin/globulin ratio. From a non-pregnant value of 1·5 the ratio gradually falls as pregnancy advances; a value of 1·45 is found in the first trimester, 1·2 in the middle trimester and 0·8 in the third trimester. Twenty-four hours after labour, the albumin/globulin ratio has fallen to a level of 0·6 but at the fifth post-partum day it has risen to 0·73.

The globulin fractions undergo many variations in amount when investigated at various stages of pregnancy and before and after labour. The α_1 fraction increases in early pregnancy, remains fairly constant in mid-pregnancy then rises again in the third trimester. Before labour the α_1 fraction decreases slightly and when labour is over it approximates to its value in the non-pregnant state. At the fifth day post-partum the amount of α_1 globulin is little different from the amount found before labour started. From the non-pregnant state to that pertaining when lactation is established, there is an appreciation of 14 per cent in α_1 globulin.

The α_2 globulin fraction increases in amount steadily from early pregnancy until just before labour, diminishes in amount after labour to the amount found during the third trimester and increases slightly when lactation is established. The increase in the amount of α_2 globulin, from non-pregnant to 5th day post-partum average values, was 55 per cent. β globulin increases over a similar period of time by 35 per cent, its value increasing rapidly until late in pregnancy, falling slightly before labour, rising in the course of labour and falling to a level which approximates to its late pregnancy value on the 5th day after delivery.

γ globulin differs from all the other globulin fractions in that its value decreases steadily from early to late pregnancy then increases until after labour. Following labour it decreases to, approximately, the same value found before the onset of labour.

Each fraction of the globulin complex increases in amount from non-pregnant to lactation value. α_1 increases by 14 per cent, α_2 by 55 per cent, β by 35 per cent, and γ by 19 per cent.

Both α factors diminish in the course of labour and increase thereafter. β and γ fractions increase in the course of labour and diminish thereafter.

The fall in total serum protein may in part be related to the hydraemia occurring in pregnancy. The anabolic effects of pregnancy on protein metabolism are reflected in the positive nitrogen balance reported by many workers. Hoffström (1910), Wilson (1916), Murlin (1916–17) and Seegers (1937) found that the positive nitrogen balance increases as pregnancy advances. These findings corroborate our findings of a steady fall in total serum protein values which is not checked until labour is over. Coons and Blunt (1930) observed that storage of protein tended to fall off towards the end of pregnancy. Our findings suggest a similar trend (Figs. 1 and 2).

Many authors have reported a similar fall in serum proteins during pregnancy (Dieckmann, 1952; Eastman, 1930; Strauss, 1935; Plass and Bogert, 1924), and it has been repeatedly shown that the fall is mainly due to reduction in the albumin fraction (Dieckmann, 1952). It has also been shown that the globulin fraction increases with a consequent reversal of the albumin/globulin ratio. What has not been clear hitherto is that the change in the globulin is not due to the same fraction at all stages of pregnancy. During the antenatal period the α and β fractions are responsible for the rise in globulin protein but at term the γ moiety shows a sudden rise. These changes in the various globulin fractions must have some vital significance which is not at present apparent. It is possible that the rise in these fractions is related to events at the time of confinement. At delivery there is always a certain amount of unavoidable blood-loss. It has been shown that there is an increase in the coagulability of blood at this time (Glass, 1950) and since many of the factors associated with coagu-

lation of blood are contained in the globulins, especially the β fraction, it may be that the rise in globulin is partly related to this phenomenon of increased coagulability. No doubt the increased activity of blood-clotting is a protective mechanism related to the shedding of the placenta. In addition, many of the immune bodies, such as diphtheria anti-toxin, etc., are passed to the foetus either by blood-stream or in the milk. Tiselius and Kabat (1939) have shown by electrophoretic fractionation that in animals antibodies are in general mainly associated with this moiety. Using similar methods Moore, Van der Scheer and Wyckoff (1940) have found that anti-pneumococcal antibodies were associated with the γ fraction. Kekwick and Record (1941) have shown that two fractions of the diphtheria anti-toxin exist, one of which migrates with the β complex and the other with the γ. It is possible that the rise in the γ globulin is related to the passage of immune bodies to the foetus during the later stages of pregnancy.

Further work along these lines will require to be done in order to determine the nature of these changes. It may be possible to relate the levels of these globulin fractions to the amount of antibody present in the maternal blood.

The tendency for reversal of these changes to occur during the puerperium has been noted. Many factors such as lactation, involution of uterus, and loss of fluid may all play their part. Harding, Allin and Van Wyck (1924) and Harding and Montgomery (1927) have noted that the nitrogen balance, previously positive, becomes negative in the puerperium. The retention of nitrogen during pregnancy is almost certainly due to hormonal influences and it may be that the storage of nitrogen occurs at the expense of the plasma proteins, particularly albumin. During the puerperium this influence is obviously removed and nitrogen may then be used once more in the restoration of the albumin fraction.

Whatever the cause of these variations, this study provides a basis for comparison with the changes in serum proteins which may occur in diseased states during pregnancy. They also supply standards which may be used in further physiological studies.

The sera analyzed in this investigation were obtained from patients in Lennox Castle Maternity Hospital.

I wish to express my thanks to Dr. A. D. T. Govan, Director of Research, Glasgow Royal Maternity and Women's Hospital, for the great help and encouragement he has given me throughout the preparation of this publication.

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SECONDARY ABDOMINAL PREGNANCY

BY

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SECONDARY abdominal pregnancy proceeding to term is uncommon; it is even more unusual for both mother and child to survive. Whitehouse (1935, p. 254) states "the extra uterine foetus, even if it survives the risks inseparable from the conditions under which it is developing and reaches term, is seldom normal in development and vitality. Malformations are remarkably frequent, and, in a series of 100 cases collected by Gordon Ley, roughly 50 per cent showed malformation. Among those born alive the early mortality is also extraordinarily high. In 112 instances collected by Sittner 59 died in the first 4 weeks, and 14 others before the end of the 1st year, giving a mortality for the 1st year of life of about 60 per cent." In the larger more recent series the mortality rate has remained substantially the same, varying between 50 per cent and 76 per cent. There has been a constant decline in the maternal mortality rate of cases of advanced extra-uterine pregnancy submitted to operation, Hudnall Ware giving a rate of just under 15 per cent for his series (collected between 1933–46).

In the case reported here the survival of the child may be largely attributed to the fortunate coincidence which led to the performing of a laparotomy before the onset of labour.

CASE REPORT

Mrs. W., a 2-gravida aged 30 years, was first seen by me when she was admitted on the 4th November, 1944, for an elective Caesarean section.

She was delivered in May, 1940 of a 6 pounds 12 ounces (3,062 g.) female infant by classical Caesarean section performed at term for contracted pelvis, after unsuccessful trial labour. The puerperium was normal.

She was seen in the out-patient department in the early months of this pregnancy and, owing to the past history, was placed on the list for Caesarean section at term, with possible sterilization, a decision reinforced by a history of recent mental instability.

Commencing during the 11th week she had attacks of acute lower abdominal pain occurring over a period of 3 to 4 weeks; the 1st lasting from 7 to 10 days, during which attack she had obstinate constipation for several days and acute retention of urine for 1 day; later attacks were shorter and less severe. Vaginal bleeding did not occur.

Progress from this time onwards was uneventful.

On examination (4th November):

She was physically fit though small and somewhat thin. External pelvic measurements were: interspinous 8½ in. (21·6 cm.); intercristal 9½ in. (24·1 cm.); external conjugate 7½ in. (19 cm.). The sacral promontory was readily palpable and intertuberous space did not admit 4 knuckles. The foetus was small, lying obliquely in the right occipito-posterior position with head not engaged. Movements were felt and the foetal heart heard. There was no abnormal mobility of the parts nor could they be palpated with undue ease. It was found at this time that there had been an error in dates, the true expected date of delivery being the 21st November; she was discharged, being readmitted on 15th November.

On readmission the foetus was still lying obliquely in the right occipito-posterior position, the foetal heart being audible immediately to the left of the midline just below the umbilicus, rate 132 per minute.

On neither occasion did examination excite suspicion.

At operation (17th November):

Under open ether anaesthesia with continuous intranasal oxygen the abdomen was opened through a right paramedian incision following the line of the previous operation scar. Upon opening the peritoneum an opaque membranous sac was discovered occupying a large proportion of the abdominal cavity and extending down behind the uterus, which was enlarged to the size of a 3-months pregnancy (see Fig. 1). The sac was firmly adherent to the uterus, especially upon the right side where large vessels were travelling posteriorly within the adhesions. The adhesions were easily stripped on the left side sufficient to make a vertical incision in the sac to the left of the midline through which the child was delivered. It responded readily.

The sac and placenta were stripped off quite easily from the attached bowel, uterus and posterior peritoneum, difficulty being experienced on the right side with the strong adhesions to the posterior surface of the broad ligament and peritoneum covering the right iliac vessels. A small portion of sac which contained the main placental blood vessels was ligated, sutured and left behind, the appendix, still firmly attached to the sac, being removed with it. Sterilization was effected by section and ligature of the left tube, and the abdomen closed in layers with a tube drain into the pelvis.

In view of the large area of stripping undertaken an intravenous drip was commenced immediately after return to the ward and continued for 18 hours giving 1 pint of plasma followed by dextrose-saline; as drainage from the tube was very slight it was discontinued after 18 hours.

The patient's condition remained good until the 3rd day when there was definite evidence of paralytic ileus, which responded within 24 hours to gastric suction and 6-hourly morphine. Further progress was satisfactory, the sutures being removed 12 days after the operation. She was up 2 days later and discharged 2 days after that with a sound wound. There was no excessive lochia, nor discharge of a uterine cast.

The baby, which was receiving complemented breast feeds on discharge, was a normal healthy female infant weighing 6 pounds (2,722 g.) at birth and 5 pounds 10 ounces (2,551 g.) on discharge.

The sac, which burrowed down into the pelvis behind the uterus, consisted of a smooth glistening inner layer covered with a thicker opaque outer layer.

Attachments of sac: Superiorly and to a small extent posteriorly—small intestine. Posteriorly and to the right—caecum, appendix and parietal peritoneum near the broad ligament reflection. On the left, laterally and running down posterior to the sac—descending colon and pelvic colon.

Antero-inferiorly—the enlarged uterus. The sac was firmly attached on the right side to the posterior surface of the right broad ligament and to the peritoneum covering the right iliac vessels by extremely vascular adhesions containing the main blood supply which appeared to originate principally from the right ovarian artery and to a lesser extent from the right uterine.

The rupture would appear to have been from the outer half of the right tube because the inner portion remained intact in the dense adhesions, whilst it was impossible to define either the outer portion or the ovary.

The placenta was lying attached to the inner surface of the sac on the left side extending up on to the fundus and round to the posterior surface. The main placental vascular supply was travelling across the posterior surface of the sac from the region of the right broad ligament and broke up before reaching the placenta. The weight of the placenta with small placenta succenturiata was 1 pound 2 ounces (510 g.).

Discussion

It might fairly be asked: "Why was the condition not diagnosed pre-operatively?" particularly in view of the history of abdominal pain during the 11th–15th weeks. The foetal parts were not abnormally palpable. The patient was not particularly intelligent and before the operation merely stated that she had been constipated for a few days early in the pregnancy. It is stated by Whitehouse (1935, p. 250) that "the recognition of this condition presents considerable difficulties, and in the great majority of recorded cases the diagnosis has not been made until, following upon the death of the foetus, the

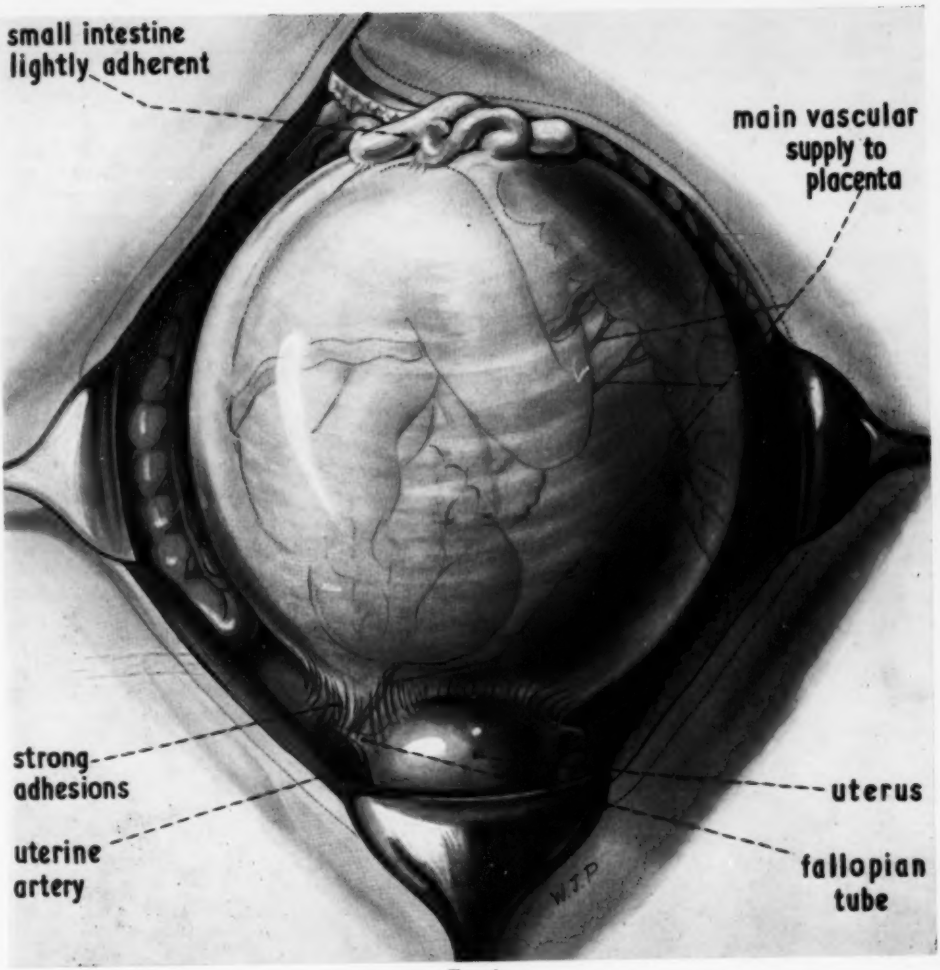

FIG. 1

To show the relations, the attached structures have been displaced outwards, and the sac has been displaced forwards at its fundus, and shown as semi-opaque whereas it was in reality opaque and of pinkish tinge.

gestation-sac has become altered by infection or by shrinkage".

Even during the operation it was not immediately obvious that this was in fact an abdominal pregnancy; the sac, which was of pinkish tinge, being taken for a very thin uterus with a stretched scar from the previous section, and the uterus itself being considered a full, abnormally muscular bladder which was obscuring the operation site. The true state of affairs was only appreciated upon incision of the sac which appeared unusually thin even for a stretched scar.

The placenta lay in the left wall of the sac whereas it is said generally to lie below the foetus (Whitehouse, 1935, p. 237). The main blood supply appeared to originate from the right ovarian and uterine arteries, with a possible supplement from the ileo-colic artery in view of the dense adhesions to the appendix in the region of the placental vessels. Removal of the gestation sac entire is considered the ideal procedure (Kerr and Moir, 1949) though usually difficult and dangerous in the case of a live foetus. The most frequently practised procedure today in the case of a live foetus is closure of the abdomen leaving the placenta *in situ*. It is interesting to note that it took 5–7 weeks for the Friedman test to become negative in 2 cases where the placenta was left *in situ* by Hudnall Ware, whereas the placental mass remains palpable for considerably longer; Robinson (1948) found palpable placental masses in 2 cases 6 and 24 months after operation; in King's case (1954) the mass did not disappear for 3½ years and, incidentally, in his case breast-feeding was established.

The child itself was normal and has continued so, though as a matter of interest it should be stated that the mother had a complete right cleft-palate and hare-lip for which operation had been undertaken some years before.

Summary

A case is described of secondary abdominal pregnancy proceeding to term, occurring in a 2-gravida of 30. Ten years later both mother and child are alive and well.

I wish to thank Mr. A. C. Liesching, consultant surgeon to the Royal Isle of Wight County Hospital, under whose care this patient was admitted and with whom this operation was performed, for his great assistance throughout and for his permission to publish; also Mr. W. J. Pardoe of the Anatomy Department, University of Birmingham, who so kindly produced the illustration.

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TWO NEW DECAPITATION INSTRUMENTS

BY

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AND

D. STAFFORD MATTHEWS, F.R.C.S., M.R.C.O.G.

IN recent years relatively little attention has been given to the problems and technique of embryotomy. This is understandable, since destructive operations are rarely performed in Europe today, antenatal care being so universal and thorough. However, the establishment of medical faculties in association with the new colonial universities in Nigeria, Uganda, Malaya and Jamaica has re-awakened interest amongst British obstetricians in embryotomy.

During 4 years in Nigeria it was clear to us after our earliest experiences that the older better known embryotomy instruments were not altogether satisfactory. The commonest problem was the neglected transverse lie, particularly the second of twins.

We set out to design cutting instruments which could be used by a single operator and which would achieve the desired result easily and quickly. The following two instruments were used successfully in Nigeria by one of us (A.H.C.W.) for two years.

(1) *The decapitating guillotine* (Fig. 1)

The instrument is based on the Ramsbotham decapitating hook and the tonsil guillotine handle. The hooked end is slotted to receive the blade which travels towards it from the resting position when the handle is squeezed together. Since it is impossible to guard both sides of the blade by the internal hand, a shield has been fitted on one side. This shield is detachable for cleaning.

The technique of introduction is as follows. After the bladder has been emptied, one hand is passed up to the foetal neck and the index finger is hooked around the neck from behind. This finger acts as a guide to the passage of the hooked end of the instrument, and also brings the neck lower down.

The hooked end is then passed, with the blade closed until it reaches the palm of the internal hand. The blade is then opened, and the instrument is turned through an angle of 90° so that the blunt end of the hook touches the guiding index finger. Care is taken to guard the soft tissues by maintaining the hand in position. If the handle end of the instrument is then moved towards the perineum, the hook is easily adjusted around the upper and anterior surfaces of the neck. The handle of the instrument is then squeezed and the decapitation affected, preferably without removing the internal hand. The hook is then withdrawn, still closed so as to avoid damage to soft tissues.

(2) *A modification of Jardine's hook* (Fig. 2)

The terminal handle is fixed at right angles to the shaft so that a firm grip can be maintained without slipping whilst performing the decapitation. A more important modification, however, is the thumb aperture on the shaft near the hooked end. This permits traction to be applied with the thumb, whilst the fingers of the same hand guide the point of the scissors which are occasionally required to cut the remaining portion of skin. This obviates the necessity for a third hand.

In practice the decapitating guillotine was found to be swiftly effective, and the heads were severed from the trunk by a clean cut as shown in the photographs (Figs. 3 and 4). On no occasion was it necessary to use scissors to cut the last portion of skin. On one occasion the angle between the head and the trunk was so acute that the modified Jardine hook was found to be the instrument of choice rather than the decapitating guillotine.

These instruments were made for us by Messrs. Allen and Hanbury, to whose representative, Mr. H. Woodhall, we are indebted for his cooperation.

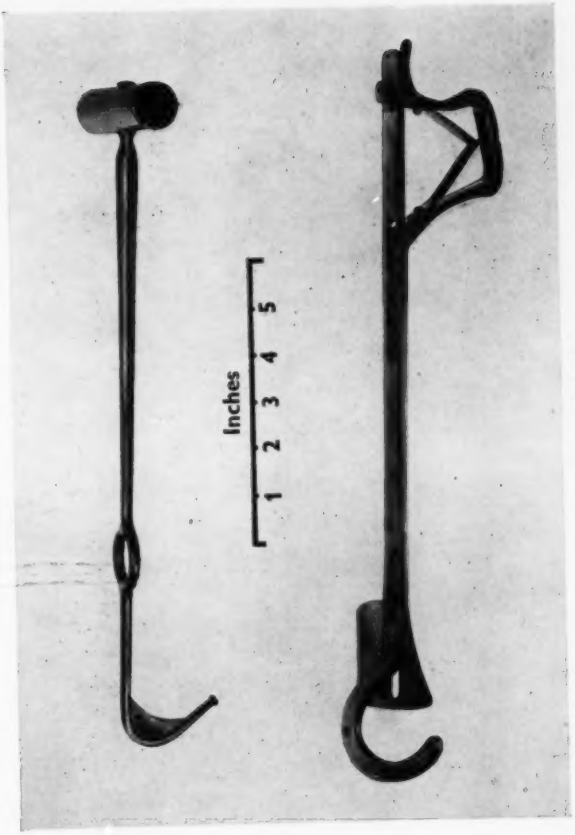

FIG. 2

FIG. 1

FIG. 1 (below)
The decapitating guillotine. The blade is shown half closed.

FIG. 2 (above)
A modification of Jardine's hook.

FIG. 3

FIG. 4

FIGS. 3 and 4

The head and trunk immediately after decapitation. The spinal column and vessels of the neck are clearly shown, and there are no ragged edges.

A.H.C.W., D.S.M.

A STUDY OF HOFBAUER'S CELLS IN THE HUMAN PLACENTA

BY

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INTRODUCTION

HOFBAUER'S cells are about three times the diameter of red blood cells and are seen in the interstitial tissue of a placental villus, often a villus that contains much lipoid material. These cells are known as Chaletzky (1891), Neumann (1897) or Hofbauer (1903) cells. They are rounded, oval or polyhedral with a homogeneous, usually abundant cytoplasm of a reddish colour, less bright than the colour of an erythrocyte, stained with haematoxylin and eosin in the same formalin-fixed section. The nucleus is round and vesicular, although as a result of degeneration it often stains as a dense structureless disc, the blue-black effect of haematoxylin. Neither the function nor the origin of Hofbauer's cell is known. These cells have been called macrophages and clasmatocytes by some authors, including Lewis (1924), who described a cell resembling the Hofbauer prototype which in tissue culture showed a marked ability to ingest and digest bacteria and various foreign bodies.

None of the Hofbauer cells examined for this investigation contained ingested particles. Hörmann (1947) stated the cells were probably of mesenchymal origin and were normally present in young chorionic villi. He thought they disappeared between the fifth and sixth months of pregnancy and they had no significance for the nutrition of the foetus. Schmidt (1948) believed that Hofbauer cells were modified stroma cells, preferred to call them "X-cells" and believed that they were associated with a diseased chorion, or were an indication of abnormal blood formation. Mall and Meyer (1921) seem to agree with the absence of phagocytosis in Hofbauer cells and are uncertain of their function.

INVESTIGATION

One or more sections were cut from each of 600 placentas. In each section 1,000 villi or more were examined microscopically as far as the thickness of the section, 4 microns, would allow. More than half of these placentas were selected because of some special condition of the mother, or because the placenta presented an abnormal appearance, or because the infant was stillborn. The placentas selected for examination included those from premature and overdue cases, from cases of twin births, from those in which the mother reacted negatively to tests on her blood with anti-D serum, and from complicated cases of pregnancy including hypertension, toxaemia, and ante-partum haemorrhage. On microscopic examination 5 placentas showed vesicular villi, but only 1 of these placentas was selected by macroscopic examination.

(1) *Mature Placentas from Cases of Normal Pregnancy*

Among 264 cases of normal pregnancy with the birth of a living child, Hofbauer cells were found in the villi of 54 or 20 per cent. Numerous cells were seen in 7 of these placentas; none of the placentas showed any other distinctive features. The Hofbauer's cells were commonly found near oval collections of lipoid substance among the supporting stroma of reticular tissue, the mesenchyme of Hamilton and Boyd (1951).

Analysis of the Results of the Microscopic Examination of 600 Placentas for Hofbauer's Cells

Type of Case	Normal Pregnancy		Twins		Rhesus Negative Cases: Primiparous and Multiparous		Rhesus Negative Cases: With agglutinins in the mother's blood		Hypertensive and Toxaemic		Antepartum Haemorrhage		Vesicular type of Villi		Totals		Percentage or approximate ratio
Number of Placentas	Examined	With Hofbauer Cells	Examined	With Hofbauer Cells	Examined	With Hofbauer Cells	Examined	With Hofbauer Cells	Examined	With Hofbauer Cells	Examined	With Hofbauer Cells	Examined	With Hofbauer Cells	Examined	With Hofbauer Cells	
Mature:																	
Live Baby ..	264	54	14	5	71	12	3	1	73	13	9	2	2	2	436	89	20
Foetal and Infant Deaths	6	3	1	—	1	1	3	2	4	—	1	—	1	—	17	6	35
Premature:																	
Live Baby ..	28	9	14	7	6	3	1	—	14	5	11	3	1	—	75	27	36
Foetal and Infant Deaths	11	5	6	4	—	—	1	—	8	3	10	5	1	1	37	18	48
Postmature:																	
Live Baby ..	32	4	—	—	—	—	—	—	—	—	—	—	—	—	32	4	12·5
Foetal and Infant Deaths	3	1	—	—	—	—	—	—	—	—	—	—	—	—	3	1	33
Totals:																	
Live Baby ..	324	67	28	12	77	15	4	1	87	18	20	5	3	2	543	120	22
Foetal and Infant Deaths	20	9	7	4	1	1	4	2	12	3	11	5	2	1	57	25	44
													Total		600	145	24

Note: There were 41 stillbirths and 16 infant deaths.

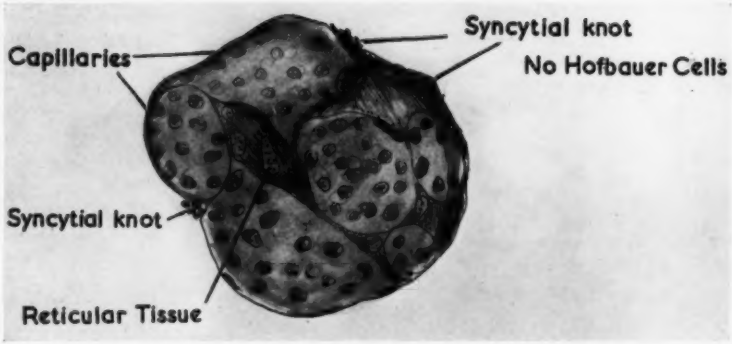

FIG. 1
Normal Villus. Congested full term Placenta.

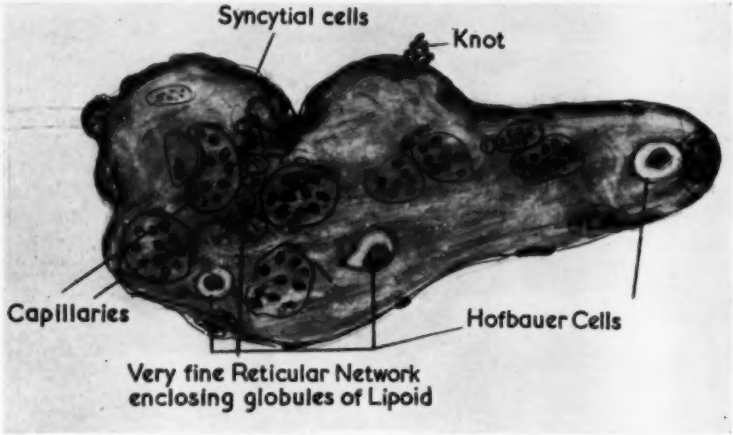

FIG. 2
Transverse section of Villus. Full term Placenta.

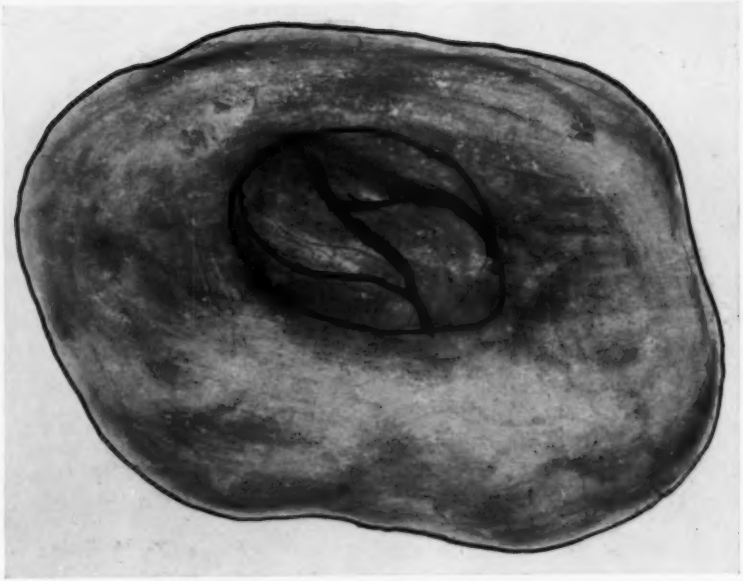

FIG. 3
Hofbauer Cell.

Deposits of lipoid were seen also in placentas without Hofbauer's cells.

(2) *Placentas from Premature Cases*

The criteria of prematurity used in this investigation were a shortened period of gestation of 38 weeks or less together with an infant birth weight of 5½ pounds or under; a shortened period of gestation only, or an infant's birthweight of 5½ pounds or less.

Among 28 premature placentas of single births from cases of normal pregnancy in which the child survived, Hofbauer's cells were found in the villi of 9. This proportion was higher than had been found in the mature placentas. Of these 9 placentas, 5 were from the first group of 14 premature births with both a shortened period of gestation and an infant of low birth weight. Numerous Hofbauer cells were seen in 2 of these placentas from cases of 32- and 38-weeks gestation respectively. Over 100 Hofbauer cells were observed in a specimen from a case estimated to have had a period of gestation of about 36 weeks, the infant birth weight being 6 pounds 2 ounces. Scanty to moderate numbers of Hofbauer cells were seen in the rest of the specimens.

As with the mature placentas no distinctive features were noted in the Hofbauer cell sections. The placental membrane (Hamilton and Boyd, 1951) of most of these premature placentas was more often thick than thin. Numerous collections of lipoid were commonly found in villi with Hofbauer's cells, but scanty amounts or none at all were found in many of the specimens without Hofbauer's cells.

(3) *Postmature Placentas*

Among 32 placentas from cases in which the duration of pregnancy was estimated to have been over 42 weeks, 2 or 3 Hofbauer's cells were found in sections of 4 only of these placentas. Moderate and profuse amounts of lipoid were seen in many of the specimens.

(4) *Placentas from Cases of Twin Births*

Among 28 twin placentas from cases of living births, Hofbauer's cells were present in the sections from 12. Of these 12 specimens, 5 were from a group of 14 mature cases and 7 were from immature cases. Sections from the mature placentas showed only a few Hofbauer's cells, but in the premature placentas moderate numbers and in 1 specimen large numbers were seen. Collections of lipoid substance were scanty or absent in 7 of the 28 placentas, including 2 which showed Hofbauer's cells.

(5) *Placentas from Rhesus Negative Cases*

In this group an examination was made of 81 placentas from living births; 7 of these were premature. Twenty-seven of the placentas were from first births and 54 from multiparae. Among the 27 primiparous placentas Hofbauer cells were found in scanty to moderate numbers in 2 of 3 premature specimens and in scanty to moderate numbers in 4 of 24 mature ones. Among the 54 multiparous placentas these cells were found in moderate numbers in 1 of 3 premature, in 8 of 47 mature, and also in 1 of 3 mature placentas from mothers with anti-D agglutinins in their blood. No Hofbauer cells were seen in sections from 1 premature placenta of this last group.

The 4 placentas from cases in which the mothers had agglutinins in their blood showed large open-textured villi with full foetal capillaries. Nucleated red cells were seen in 1 of the 3 mature placentas and in the premature one. The intervillous spaces contained scanty to numerous red cells but *no* normoblasts were seen outside the villi in any section from the 4 placentas. Abundant lipoid substance was seen in 2 of the 3 mature placentas and also in the premature specimen.

(6) *Placentas from Cases of Hypertension and Toxaemia*

In this group 87 placentas from live births were examined; 14 of these were premature specimens. Forty-seven, including 4 premature ones, were from cases of early hypertension in which before or up to the 20th week of pregnancy a systolic blood-pressure of 130 mm. Hg or more, or a diastolic pressure of 90 mm. Hg or over, had been recorded more than once.

Twenty-three, including 3 premature specimens, were from cases of hypertension first

recorded after the 20th week, and 17 with 7 premature ones were from cases of hypertension and albuminuria. Among the early hypertensive group, Hofbauer cells in scanty to moderate numbers were found in 9 of the 43 mature placentas, and a few were seen in 1 and many in another of the 4 premature placentas.

In the late hypertensive group a few Hofbauer's cells were found in 2 of 20 mature placentas and a moderate number in 1 of 3 premature specimens.

In the toxaemic group, a few Hofbauer cells were seen in 1 of 10 mature placentas; a large number was seen in 1 premature placenta from a case of a 30-weeks gestation and a moderate number in another premature specimen.

Deposits of lipoid varied from scanty to profuse amounts, but in 1 early hypertensive case and 1 toxaemic case with Hofbauer's cells none was seen.

(7) *Placentas from Cases of Ante-partum Haemorrhage*

Among 20 placentas, including 11 premature ones, from cases in which the infant was born alive, Hofbauer cells were found in scanty to moderate numbers in 2 mature placentas, 1 from a case of accidental haemorrhage and 1 from a case of placenta praevia, and also in scanty to large numbers in 3 premature placentas from a group of 7 cases of accidental haemorrhage.

In 4 premature placentas from cases of placenta praevia Hofbauer cells were absent.

A distinctive feature of the sections from these 20 placentas was the high proportion that showed few erythrocytes both within and outside the villi.

(8) *Placentas Showing a Vesicular Structure in the Villi*

Two mature placentas and 1 premature placenta, from cases of living births, showed large swollen villi resembling those seen in a vesicular mole. About 12 Hofbauer cells were observed in the section from the 2 mature placentas but none in the premature one.

The only other special feature of the sections from the 3 placentas in this group was the very much increased accumulation of lipoid substances in some of the villi.

(9) *Placentas from Cases of Stillbirth*

Forty-one placentas were examined, 13 mature, 26 premature and 2 postmature. Hofbauer cells were found in scanty to moderate numbers in 5 of the 13 mature placentas, in moderate to large numbers in 11 of the 26 premature placentas and 3 Hofbauer cells only were seen in the sections of 1 of the 2 postmature cases. Among the 5 mature placentas with Hofbauer cells there were 2 from cases of erythroblastosis. Of the 11 premature placentas showing Hofbauer cells from cases of pregnancies ranging between 32 and 38 weeks, all but 1 were from cases with a macerated foetus.

Numerous Hofbauer's cells were found in 8 of the 11 premature placentas, including 1 from a recent stillbirth. Four of the placentas were from cases of ante-partum haemorrhage with retroplacental clots; 2 were from cases of early hypertension and 1 was from a twin case. Moderate numbers of the cells were seen in the 3 other premature placentas, 1 from a case of eclampsia, another from an anencephalic twin case, and the third from a case of severe enteritis at the 34th week of pregnancy.

(10) *Placentas from Cases in which the Infant Died*

Among 16 placentas, 11 of them premature ones from cases in which the infant died from a few hours to within 4 days of birth, Hofbauer cells were found in 1 of 4 mature placentas, and in 7 of 11 premature specimens. In the postmature placenta no Hofbauer cells were seen. A few Hofbauer cells only were seen in the mature placenta which was from a case in which the child died shortly after birth from erythroblastosis and a congenital malformation of the heart.

In 4 premature placentas from pregnancies estimated to have been between 28 to 32 weeks numerous Hofbauer's cells were seen. One of these placentas showed a vesicular structure of the villi: 1 was from a case of ante-partum haemorrhage with a retroplacental clot. Scanty Hofbauer cells were found in 3 of the premature placentas, 1 from a case of congenital malformation of the heart in a child premature by weight (4 pounds 10 ounces) but from a pregnancy estimated to have lasted 40 weeks. The other 2

were from cases of 32 weeks pregnancy, 1 a twin case.

The cause of infant death in 6 of the 7 cases with Hofbauer cells was given as atelectasis and prematurity.

Summary

The results are given of the microscopic examination for Hofbauer cells of sections from 600 placentas. In 543 of these, from cases with a surviving child, Hofbauer's cells were found in the villi of 120 or 22 per cent and in 57 from cases of stillbirth and infant death the cells were found in 25 or 44 per cent.

The number of placentas with Hofbauer's cells was higher, 1 in 2, for the premature stillbirth and infant death cases than for the mature specimens in which it was 1 in 3. More Hofbauer's cells were commonly seen in both mature and premature placentas of this group than in those from living birth.

Among cases with a surviving child the number of placentas with Hofbauer's cells was higher for premature cases and also for twin cases—both premature and mature—than for mature cases of single birth, and a greater number of cells was often found in both premature and twin placentas than in mature ones.

Among 436 mature placentas, Hofbauer's cells were seen in 89 or 20 per cent against 27 or 36 per cent of premature ones and 12 of 28 twin specimens; only a few cells were seen in 32 postmature placentas.

None of the Hofbauer's cells showed ingested particles suggesting a phagocytic function, but it is thought that the cells may be concerned with endocrine or immune processes, more, it would seem, with the humoral than the cellular aspect of such phenomena.

We would like to thank Dr. I. M. Tuck of the Pathology Department, St. Margaret's Hospital, Epping, for having the sections prepared for this study.

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THE VALUE OF BLOOD URIC ACID LEVELS IN TOXAEMIA OF PREGNANCY

BY

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THE prevention of severe pre-eclampsia and eclampsia has become today the main problem of toxaemia of pregnancy. To be able to prevent it, we must diagnose the disease at its earliest beginnings.

The triad of high blood pressure, oedema and albuminuria is neither specific nor sensitive enough, therefore a reliable blood examination is needed to solve our problem.

The following 5 characteristics are demanded of such an examination: simplicity, reliability, diagnosticity, sensitivity and having a prognostic value.

Many constituents of the blood or the urine have been tried, but none have answered more than two or three of the above mentioned demands. They include for example: blood sugar level (Titus, Willetts and Lightbody, 1930; Stander, 1932); guanidine (Stander, 1932); the specific gravity of urine, urea nitrogen/non-protein nitrogen ratio, phenolsulphonephthalein (PSP) excretion and urea clearance (Chesley, 1939; Stander, Ashton and Cadden, 1932); anterior pituitary-like (APL) hormone (Smith and Smith, 1939); pentoses in the serum (Green, Hopewell and Threlfall, 1951) and even the corticosteroid hormones secreted by the placenta (Mastboom, 1953).

Stander, Ashton and Cadden (1932) were among the first to mention that blood uric acid is elevated in toxaemia of pregnancy. We have tried to evaluate this finding and see whether it possesses the five characteristics.

MATERIAL

During the 6½ years between 1947 and the middle of 1953 there have been 29,670 deliveries in our hospital. Out of these, there were 469 cases of toxaemia of pregnancy, a ratio of 1:63·2; 51 cases of simple (or idiopathic) hypertensive disease and 2 cases of nephritis. We deal therefore, in this paper, with a total of 522 women. The number of eclamptic patients has been 49 (i.e., 1:605·5).

All these patients (excluding the 2 nephritic cases) have been divided into 4 groups; hypertensive disease (group 1), mild pre-eclampsia (group 2), severe pre-eclampsia (group 3) and eclampsia (group 4). The grouping was made according to the clinical picture, mainly the blood pressure and albuminuria.

RESULTS

(1) Figure 1 shows the curves representing the various groups, the abscissa being the blood uric acid level and the ordinate the number of cases. The peak of each group is to the right of the preceding one, i.e., as the case becomes more severe, the blood uric acid tends to be higher. This is shown even more strikingly by Figure 2, where the average (mean) value of blood uric acid for the different groups is seen.

(2) Table I shows the ratio between blood urea and uric acid. This ratio differentiates neatly between non-toxaemic hypertension and

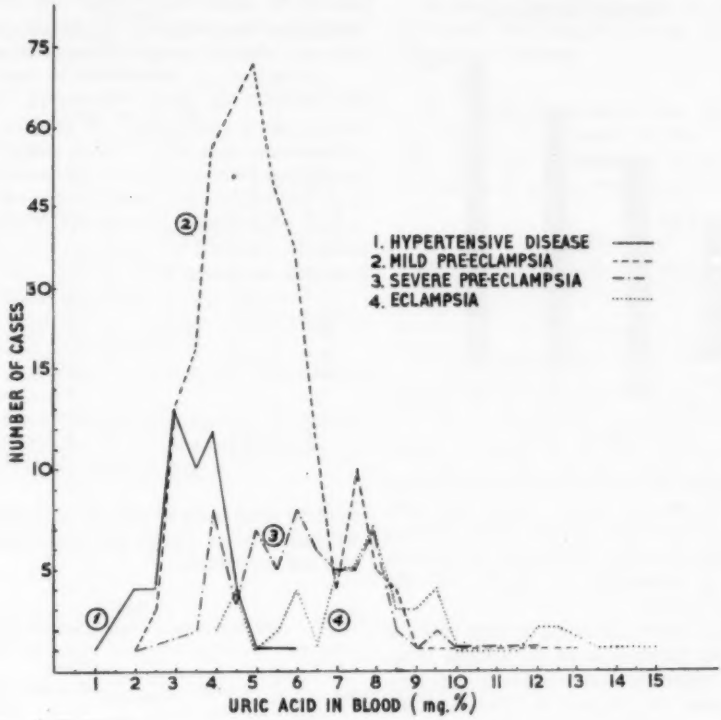

FIG. 1

toxaemia, but has no prognostic value in the latter groups.

TABLE I
Blood Urea/Uric Acid Ratio

Group	Mean Uric Acid (mg. per cent)	Mean Urea (mg. per cent)	Urea/Uric Acid Ratio
1 ..	3·4	35·5	10·44
2 ..	5·0	24·1	4·78
3 ..	6·24	28·7	4·60
4 ..	7·46	36·3	4·86

(3) Table II compares the levels of uric acid to blood pressure and the level of albumen in the urine in the two higher groups. It can be seen that uric acid gives a more reliable picture than the systolic blood pressure.

Table III shows the number of cases in which

TABLE II
Comparison of Blood Uric Acid with Blood Pressure and Urine Albumen

Group	Mean Blood Pressure (systolic) mm. Hg	Mean Urine Albumen (pro mille)	Mean Uric Acid mg. per cent
3 ..	182·7	3·22	6·24
4 ..	171·5	6·97	7·46

TABLE III
Number of Cases with Normal Values

Group	Blood Pressure	Urine Albumen	Uric Acid	Total Number of Cases
3 ..	0	7	3	64
4 ..	5	10	1	49

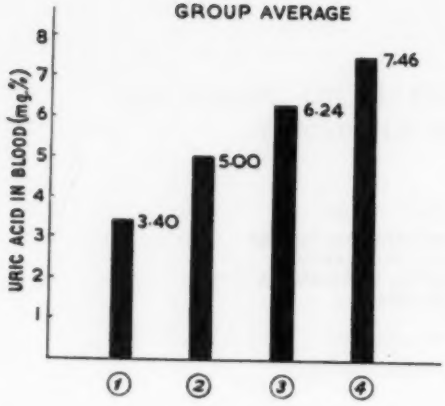

FIG. 2

the three values were normal. (Normal being: systolic blood pressure at or below 140 mm. mercury; blood uric acid up to 4·0 mg. per cent and up to such quantity of albumen in urine as could not be expressed in figures by the Brandberg method.)

The inference from Table III is: first that the level of blood pressure is of no certain prognostic value; secondly that in quite a high proportion of cases (in group 3 in almost 11 per cent and in group 4 in more than 20 per cent) we cannot rely at all on the level of albumen in the urine. On the other hand, the number of cases in which the blood uric acid level will not show the true severity of the disease is quite low (4·6 per cent in group 3 and 2·0 per cent in group 4). We can therefore rely more on the latter finding, even as a diagnostic means, than on the well established examinations of blood pressure and albumen in the urine.

(4) In 33 cases of eclampsia we have taken daily measurements of blood uric acid. In Table IV we show 2 or 3 *consecutive* findings of the 32 cases that have recovered (after treatment and/or delivery). The sensitivity of this examination is seen by the prompt (i.e., within 24–48 hours) change when the status of the patient tends to improve. The examination is therefore of definite prognostic value.

(5) The 5 fatal cases are analyzed in Table V. The only finding that is constantly abnormal

TABLE IV
Consecutive Daily Levels of Blood Uric Acid Showing Definite Change—Eclamptic Cases
(see text)

In mg. per cent	
4·7 → 8·1 → 5·3	5·6 → 7·8 → 3·5
9·6 → 4·0	6·4 → 3·6
4·9 → 4·1	8·0 → 4·8
11·4 → 5·2	6·8 → 4·2
6·7 → 13·6 → 6·8	5·7 → 3·0
6·8 → 2·7	6·2 → 2·1
6·8 → 15·0 → 2·9	6·2 → 3·6
7·3 → 4·7	12·7 → 7·2
12·5 → 6·1	5·8 → 3·3
9·3 → 12·1 → 8·6	8·0 → 4·4
9·0 → 4·2	5·0 → 5·8 → 4·1
8·4 → 5·2	6·0 → 7·3 → 3·8
7·0 → 2·6	7·6 → 3·6
7·0 → 4·5	12·0 → 3·3
8·8 → 4·2	8·0 → 4·5
8·5 → 6·0	9·3 → 4·3

in these cases is the blood uric acid. In case No. 1 we had time to repeat this examination and it showed an increase.

TABLE V
Analysis of the 5 Fatal Eclamptic Cases

No.	Uric Acid (mg. %)	Urea (mg. %)	Blood Pressure mm. Hg	Urine Albumen (pro mille)	Eyeground Examination
1	8·8–10·2	53	240/150	6·0	Haemorrhages
2	12·0	86	180/130	+++	— —
3	8·3	60	190/120	++	0
4	9·5	21	220/150	9·0	0
5	5·6	26	180/100	12·0	— —

CONCLUSIONS

Considering the relatively large number of observations, we think that we may conclude that the level of blood uric acid can serve as a good laboratory indication in toxaemia of pregnancy. It answers the five requirements we have posed:

(*a*) It is simple, being easily performed in any laboratory.

(*b*) It is reliable; it should not mislead us, as the other clinical entities in which it is high are easily differentiated from toxaemia.

(*c*) The test is diagnostic: the blood uric acid

has shown the lowest percentage of normal findings in severe pre-eclampsia and eclampsia.

(*d*) The uric acid level is sensitive: it serves as a true mirror of the severity of the disease.

(*e*) It is prognostic: being so sensitive, the test can serve us as a prognostic guide. If uric acid decreases, it is a sign that conservative measures have improved the state of our patient.

In order to differentiate toxaemia from primary kidney disease and hypertensive disease, we should test routinely for the level of blood urea as well. Having both urea and uric acid results, we can conclude as follows:

(i) High uric acid and normal urea is a sign of toxaemia of pregnancy.

(ii) Both are low in idiopathic hypertensive disease.

(iii) When both components are high, we should concentrate on the kidneys and perform the usual kidney function tests.

In conclusion, we think that the result of blood uric acid examination should be more relied upon than hitherto.

We wish to express our thanks to Dr. Asherman, the director of the Department of Obstetrics and Gynaecology in our hospital, for his guidance in the preparation of this work.

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LENGTH OF GESTATION OF EAST AFRICAN WOMEN

BY

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IN recent years much interest has been aroused in the length of gestation and the incidence of prematurity and postmaturity with relation to foetal loss. With a view to assessing the importance of these in Africans, among whom foetal loss is a serious problem, series of cases delivered at Mulago Hospital, Kampala, have been investigated with regard to birth weight, neonatal head measurement and estimated length of gestation. The series includes Uganda natives of numerous tribal groups and several widely diverse racial types, 60 per cent being of Bantu extraction, 20 per cent Nilotic and the remainder mainly Hamitic.

Birth weight. There is no doubt that the average birth weight of coloured infants is lower than that of the white and, consequently, a high proportion of underweight babies is found among the coloured races. The 2,500 infants studied in this series proved no exception (Table I).

Study of the weight charts during the first few days of life showed the usual pattern, the initial loss being slightly less and the regaining of birth weight slightly more rapid than is the case in white children according to Naish and Edwards (1952) and Wickes (1952) respectively. The slight differences are probably due to more rapid establishment of lactation among these patients and the otherwise normal weight charts indicate that the low birth weight is due to a true deficiency of body tissue rather than any upset in fluid balance.

Survival rate. Taback (1951) has noted that coloured American children have better survival rates than white children of similar birth weight and he suggests that the negro child of 2,320 g. birth weight is comparable to a white infant of 2,500 g. At Mulago the difference in survival rate is considerably more pronounced (Table II) and, although the care of these infants is necessarily primitive and hampered by lack of equip-

TABLE I

Comparative Birth Weights

	America (Taback, 1951)		South Africa (Salber and Bradshaw, 1951)		Britain (Gibson and McKeown, 1952)	Mulago	
	White	Negro	White	Bantu	White	Bantu	Non-Bantu
Average Birth Weight (pounds) ..	7·13	6·63	7·44	6·75	7·38	6·44	6·38

TABLE II

Neonatal Death Rate of Premature Infants according to Weight-Group

Birth Weight (pounds)	–2	2–3	3–4	4–5	5–5½	Total
Number of Cases	5	26	75	179	189	474
Neonatal Death Rate (per cent)	100	84·6	30·7	7·9	2·2	14·3
Cases Born in Hospital	1	12	65	154	178	410
Neonatal Death Rate (per cent)	100	76·7	24·7	6·5	1·7	9·5

ment and specialized staff, the results are better than those obtained in a model institution in the United Kingdom (Crosse, 1952). It is impossible to estimate the value of adequate care of the premature infant but it is undoubtedly considerable and the premature white infant must, therefore, be equalled in physiological performance by an African child of much lower birth weight.

Neonatal head measurements. The series included 402 unselected, single infants born spontaneously. Cases with excessively moulded heads were excluded. The occipito-frontal, bi-parietal and bi-temporal measurements were taken with obstetric calipers and checked against a steel tape. The occipito-frontal circumference was measured as described by Ellis and Lawley (1951). All measurements were taken personally by the author, within 12 hours of birth and repeated on the fourth day of life.

Ninety-seven per cent of the cases showed an increase in the occipito-frontal circumference in the first 4 days of life and, with little variation, this amounted to 0·25 inches. In the remaining 12 cases the measurement was unchanged. This increase is not found among European babies, where, in fact, Ellis and Lawley found an almost constant decrease, and is probably due to greater moulding of the heads associated with a high incidence of disproportion among these patients.

The results show that the average East African child has a larger head at birth than American or European children (Table III) and, when the cases are grouped according to birth weight (Table IV), the difference is seen to be more marked among the lowest weight groups. An African child of 4 pounds has the same head size at birth as the European child weighing 5½ pounds.

Estimated length of gestation. The unreliability of the African memory rendered careful selection of patients necessary in this series and, in over 2,500 cases delivered in hospital, only 366 satisfied the rather stringent requirements. That is to say, they attended the antenatal clinic in the first 10 weeks of pregnancy and their menstrual history was confirmed by careful bimanual examination. Only pregnancies resulting in single live births were considered.

The results are compared in Table V with figures reported for American and Scottish children and show a marked tendency to postmaturity, the average length of gestation being 42 weeks. When the cases are grouped according to length of gestation and the average birth weights compared with those of white children (Table VI), the difference is again found to be most marked among the more premature groups

TABLE III

Comparative Foetal Head Measurements in Centimetres

	America (Riggs, 1904)		Britain (Ellis and Lawley, 1951)	Mulago (1954)
	White	Negro	White	Negro
Occipito-frontal diameter	11·71	11·26	—	11·75
Bi-parietal diameter	9·25	9·05	—	9·30
Occipito-frontal circumference	—	—	33·76	35·10

TABLE IV

Occipito-frontal Circumference according to Birth Weight

Birth Weight		4	4½	5	5½	6	6½	7	7½	8	8½	Total
Mulago	Number of Cases ..	5	6	20	36	78	75	77	58	27	20	402
	Average O-f.C. (inches) ..	12·3	12·7	13·1	13·4	13·5	13·8	13·9	14·1	14·2	14·4	13·7
Britain	(Ellis and Lawley, 1951) Average O-f.C. (inches) ..	—	—	11·8	12·2	12·6	13·0	13·4	13·8	14·2	14·7	13·3

TABLE V

Distribution of Cases according to Length of Gestation

Length of gestation (weeks)	–34	35	36	37	38	39	40	41	42	43	44–
Number of Cases	6	4	7	10	10	38	63	83	93	40	12
Percentage of Total Cases	1·6	1·1	1·9	2·7	2·7	10·4	17·2	22·7	25·4	10·9	3·3
Percentage of American Births (Taback, 1951)	2·9	1·1	2·4	4·0	8·2	18·6	23·2	20·1	9·3	4·6	5·6
Percentage of British Births (Gibson and McKeown, 1951)	1·6	1·5	2·6	4·5	8·8	20·4	28·9	18·4	8·2	3·0	2·1

TABLE VI

Average Birth Weight according to Length of Gestation

Length of gestation (weeks)	–33	34	35	36	37	38	39	40	41	42	43–
Number of Cases	3	3	4	7	10	10	38	63	83	93	52
Average Birth Weight (pounds)	3·19	3·74	4·00	4·63	5·13	5·25	6·06	6·44	6·94	7·38	7·63
Average Weight of American Births (Taback, 1951)	5·51	6·06	6·38	6·55	6·78	6·94	7·34	7·30	7·72	7·44	7·61
Average Weight of British Births (Gibson and McKeown, 1951)	4·43	5·47	6·25	6·67	6·79	7·09	7·40	7·63	7·77	7·83	7·83

and it rapidly diminishes as the babies become postmature.

Conclusions. In head size and length of gestation, the white infant of 5½ pounds birth weight is equalled by an African infant of 4 pounds and this weight difference is maintained in the more premature groups. Accordingly, estimates of the incidence of prematurity and comparison of survival rates should make allowance for this difference in weight. When this is done a low incidence of prematurity is found and, although the survival rates then compare unfavourably with those obtained elsewhere, this is in part due to the frequency of difficult labour and prematurity accounts for only a small proportion of the foetal and neonatal deaths.

Postmaturity on the other hand is common and is a much more important factor in the high foetal loss among Africans. While some of the stillbirths may be due to postmaturity alone, the majority of stillbirths and neonatal deaths are associated with difficult labour and in this respect the larger head size of the postmature infant is undoubtedly of importance. Careful attention to the length of gestation of the individual patient, with induction of labour in appropriate cases, therefore, is of primary importance in reducing this high foetal loss.

DISCUSSION

Low birth weight associated with prolonged gestation and large head size is apparently peculiar to the African negro as similar results have not been found among the coloured races in America. American negroes do have a low average birth weight but they have smaller heads and, according to Anderson, Brown and Lyon (1943), their average length of gestation is shorter than that of the white races. Also no significant differences were found among the various tribes comprising this study. Racial and hereditary factors can, therefore, be discounted and some local factor influencing birth weight and length of gestation must be assumed.

It is of interest to consider the possible role of disordered oestrogen metabolism which is common among these patients. Davies (1949) has pointed out the frequency of hyperoestrinism among the males of these races. He suggests that this is due to the almost general liver damage, the damaged liver being unable to metabolize oestrogen. A similar syndrome has been reported in cases of liver cirrhosis (Glass, Edmundson and Soll, 1940). In the female, however, and particularly in pregnancy, the problem is more complicated than one of simple hyperoestrinism and rather one of disordered oestrogen metabolism.

Although the mechanism governing the onset of labour is still obscure, it has been established that changes in oestrogen metabolism are important factors (Cohen, Marrian and Watson, 1935; Smith, Smith and Schiller, 1941; Reynolds, 1949). In the African patient the damaged liver is likely to be inefficient in producing the necessary changes with, as a result, the delayed onset of labour and prolongation of gestation. Little is known of the factors influencing birth weight. Maternal nutrition has little effect (*People's League of Health*, 1942) and even in gross malnutrition the weight loss amounts to only 6–7 ounces (Dean, 1950). A weight loss of 1½ pounds is found in this series and some factor other than diet, maternal age or parity must be involved. It has been claimed that the administration of thyroid extract reduces birth weight (Arnold, 1940) and a tendency to hyperthyroidism in these patients, due to inefficient metabolism of thyroxin in the liver, is a possible factor. Alternatively, as Hammond (1944) suggests, some other internal secretion may be the limiting factor. In any case, it is probable that defective liver function is the primary cause of the low birth weight among these patients. It is important to note, however, that the reduction in birth weight does not affect the size of the foetal head and, therefore, does not reduce the incidence of disproportion, a fact which may have been overlooked by advocates of foetal weight reduction in the management of contracted pelvis.

The aetiology of other important problems, such as pre-eclampsia, uterine prolapse and abnormal uterine action, all of which are rare among East African natives, may similarly be related to oestrogen metabolism. Much work has been done on hormonal imbalance in pre-eclampsia among the white races and work at present in progress at Mulago suggests that the efficient uterine action and absence of uterine prolapse among East African patients is primarily due to marked laxity of the cervix, pelvic ligaments and soft tissues in labour, a phenomenon which is almost certainly under endocrine control. The rarity of these conditions among patients with inefficient oestrogen metabolism suggests that this metabolism is in some way an important aetiological factor and it is likely that hormonal assays, which have yet to be undertaken in Africa, would do much to elucidate the aetiology of these problems so important to the white races.

Summary

Cases delivered at Mulago Hospital have been investigated as regards birth weight, foetal head size and length of gestation. The African child of 4 pounds is found to be as mature as the white child of 5½ pounds. Postmaturity is found to be common among these patients and is an important cause of foetal loss.

The possible relation of disordered oestrogen metabolism to the low birth weight and prolonged gestation and to the rarity of pre-eclampsia, abnormal uterine action and uterine prolapse among these patients is discussed.

I wish to thank Dr. H. Mansfield and Professor G. Rendle Short for allowing me to study cases admitted under their care.

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ROYAL COLLEGE OF OBSTETRICIANS AND GYNAECOLOGISTS

A MEETING of Council was held in the College House on Saturday, 28th January, 1956, with the President, Mr. Charles Read, in the Chair.

The following was admitted to the **Membership of the College** *in absentia:*

Laurence Maurice Jacks.

The following were elected to the **Membership of the College:**

Edgar Austin Agius.
Dennis Geoffrey Bonham.
Reginald Bowman.
Redmond John Michael Byrne.
Joseph Kevin Craig.
Cornelius Alphonsus Cussen.
Rex Patrick De Bond.
Ronald Rutherford Elvidge.
Lynn Anthony James Evans.
Jack Eyton-Jones.
Carlton Oswald Fung-Kee-Fung.
James Gordon Furber.
Reynold Harold Gelb.
Anne Louis Margaret Graham.
Winifred Jean Alexander Graham.
Ronald George Harbison.
George Francis Wilkie Hossack.
Anna Ruth Kemp.
Edward Lacy.
John Derek Llewellyn-Jones.
Margaret Beth Malloch.
John Mander.
Marc Denis Manion.
Brian Measday.
Rhoderic William Arthur Nel.
James Patrick O'Neill.
Gordon Maurice Parkin.
Herbert Erik Reiss.
Lawrence Lardner Relf.
Freda Milner Roberts.
Struan Birrell Robertson.
Albert William Russell.
Jean Mary Sharpe.
Pieter Ferdinand Venter.
Frank Charles Wilkinson.
Leonard Maurice Wolf.

Dr. Rhoda Allison of Leeds has been awarded the *Edgar-Gentilli Research Scholarship.*

REPORTS OF SOCIETIES

NORTH OF ENGLAND OBSTETRICAL AND GYNAECOLOGICAL SOCIETY AND BIRMINGHAM AND MIDLAND OBSTETRICAL AND GYNAECOLOGICAL SOCIETY

SEPTEMBER 1955

A Joint Meeting of the North of England Obstetrical and Gynaecological Society and the Birmingham and Midland Obstetrical and Gynaecological Society was held at Nottingham on 30th September, 1955, with the Presidents, Mr. H. J. Malkin and Dr. Lindsay M. Park, in the Chair.

Mr. C. J. Dewhurst opened the discussion on

RUPTURE OF THE UTERUS

Rupture of the uterus could be one of the most serious accidents of pregnancy and labour, the details of these alarming cases remaining vividly—the pulseless collapsed patient, the foetus and placenta expelled through the uterine rent, and the urgency of the operation. The aetiology was so often that of the neglected transverse lie, the unrecognized hydrocephalus, pelvic contraction in the grand multipara, the ignorant use of oxytocics and the classical Caesarean section, but not all cases had their causation in such gross abnormalities. The reason might have been that minor uterine damage had previously occurred from an extensive cervical tear, or following difficult manual removal of the placenta, or evacuation of the products of conception by sharp curettage leaving a weakness in the uterine wall which had given way during labour, possibly due to nothing more than a slightly larger child or a small degree of extension of the head.

Mr. Dewhurst divided the causes of uterine rupture, excluding previous Caesarean section, into two categories: (1) where some obvious gross abnormality existed, and (2) where no such major fault could be found.

In the past cases in the first group had greatly exceeded those in the second, but more recently the relative frequency of these cases was changing. This was due to the greater ease with which the gross faults such as transverse lie or hydrocephalus could be recognized, than could the injury to muscle fibres produced by dilators or curette, the existence of which was for the most part not even suspected.

More widely available obstetric care, hospital booking of suspect cases and the general awareness of the dangers of multiparity had all helped in the reduction in frequency of obstructed labour. Consequently, although the number of cases of rupture of the uterus was reduced, the percentage of cases without obvious cause was greater. To illustrate the changing aetiology of uterine rupture Mr. Dewhurst showed slides of the cases seen at the Jessop Hospital and City General Hospital, Sheffield since 1951. Of the 8 cases, 6 ruptures were spontaneous and 2 traumatic. One of these 2 cases showed that gross abnormalities such as transverse lie could be overlooked, and the mere introduction of a hand into the uterus could precipitate rupture. The second traumatic case showed the danger of a large baby, rupture of the uterus being due to difficulty with the shoulders. Three of the spontaneous cases were unexplained, one patient had previously had a Fothergill colporrhapy; in one case pregnancy was in a rudimentary horn and rupture occurred at the 29th week; and in the last curettage had previously been performed for septic abortion.

The problem of diagnosis presented by such a case of uterine rupture in the absence of sufficient reason for its occurrence was more difficult than in the classic case. Whilst the tear was small uterine contractions might persist and even vaginal delivery take place. As the foetus had not been expelled through the tear into the peritoneal cavity, abdominal signs might be minimal and vaginal bleeding absent. The importance of bearing rupture of the uterus in mind could not be over-emphasized, and if delivery had occurred the uterus should be explored.

When signs of shock and collapse appeared for no apparent reason in the middle of a seemingly normal labour, or even during pregnancy, the suspicion of uterine rupture might not easily arise. Even though it was possible to decide that internal bleeding was in progress the absence of the common precursors of uterine rupture might postpone the making of the correct diagnosis, so that operation might be too long delayed.

So far little mention had been made of rupture following Caesarean section. There could be little doubt that the use of the lower segment operation had had a marked effect both on the incidence and the severity and prognosis of rupture of the scar. The frequency with which the scar ruptured in subsequent pregnancy or labour depended on several conditions such as the number of patients allowed to go into labour again. The greater safety from subsequent rupture afforded by the lower segment scar was shown in figures from St. Mary's Hospital, Manchester. In 703 patients, who had 847 previous operations, 619 had 744 operations by the lower segment route, 68 had 103 classical sections, and 16 patients had both types of operation. In subsequent pregnancy and labour 3 (0·4 per cent) lower segment scars ruptured compared with 7 (6 per cent) classical scars. As the majority of lower segment scars did not rupture until labour began, a more practical figure was the chance of rupture if the patient was allowed to go into labour, the figure then being 1 in 122 or 0·8 per cent.

Cases of rupture of the lower segment were so

uncommon that one's experience of them was limited and it became necessary to examine the reported cases to get a clear general clinical picture. Mr. Dewhurst had been able to find only 22 cases reported since 1945 with sufficient detail, and 3 cases in his own series. In comparison with the severe collapse often presented when the classical scar ruptured, these cases proved interesting. In only one case was collapse present; in 13 signs were present but the condition of the mother was unchanged and in 11 cases the finding was a chance one.

Foremost among the physical signs in this form of rupture had been the recent onset of pain and tenderness in the scar. This was not always a reliable sign and the uterus might be found perfectly sound when the abdomen was opened. Membranes bulging through the tear to produce a swelling similar to a distended bladder had been noticed on at least 3 occasions, whilst too easy palpation of foetal parts in this region had also led to the suspicion of rupture. Haematuria due to simultaneous rupture of the bladder which was doubtless adherent to the scar was a significant physical sign, and should indicate urgent operation. The continuation of uterine contractions despite rupture was an important feature which might seriously delay diagnosis if its significance was not recognized.

The slower progress of the tear, the smaller amount of bleeding and the foetus remaining in most cases *in utero*, all gave rise to a less serious clinical picture than the rupture of the classical scar, and, provided the significance of the few physical signs which might appear was recognized in time, laparotomy could easily be carried out on a fit patient to save both her and the child.

Since 1945 Mr. Dewhurst had collected from the English literature information about 79 ruptured classical scars and 32 lower segment scars. The maternal results showed 3 deaths in the classical group and none in the lower segment group. There was a foetal loss of 41 in 60 cases of ruptured classical scars where this information was given, compared with a loss of 2 out of 26 for lower segment scar rupture.

Mr. Dewhurst thought that diagnosis presented the greatest problem, and that, with the aid of blood transfusion, antibiotics and first-rate anaesthesia, the patient should be saved with early action. Unless the diagnosis of uterine rupture was kept in mind in cases of unexplained collapse, errors would be made. Only if the lower segment operation superseded the classical operation almost exclusively could vaginal delivery be allowed with equanimity, and by so doing justify many of the temporary indications for Caesarean section.

Dr. S. Davidson read the second paper on

Rupture of the Uterus

During the 47 years, 1908–1954, there were 54,000 deliveries at the Birmingham Maternity Hospital with 71 cases of rupture of the uterus, an incidence of 1 in 760. The maternal mortality was 50 per cent.

The incidence of rupture of the uterus mounted steadily from 13 cases in 1908–1919 to 19 in 1930–1939. In the period 1940–1949 there was a drop to 11 cases, and in the last 5 years there had been 12 cases. Delivery trauma accounted for 23 cases, operative trauma 28, 18 ruptures were spontaneous, in 1 case pitocin had been given and the cause of 1 rupture was unknown.

Trend of Events

The causative factors showed the following trends:

(1) *Delivery trauma*. There were 9 cases of this type of rupture in 1908–1919 with a drop to 5 cases in the next 10 years and 7 cases in the period 1930–1939. Two cases only occurred in the years 1940–1949 and since then there had been no case.

(2) *Natural trauma*. The cases arising from natural trauma resulting in so-called "spontaneous rupture" showed a constant figure up to 1939 for each 10-year period (4, 5, 5). There was only 1 case in the years 1940–1949, but in the last 5 years there were 4 cases.

(3) *Operative trauma*. The first appearance of Caesarean section scar rupture or rupture associated with other operative trauma occurred in the 1920–1929 era, when there were 5 cases. There was an increase to 8 cases in the next 10-year period, and this figure was maintained during the 1940–1949 era, when the figures for the other two main causes fell. In the last 5 years there were 7 cases.

(4) *Pitocin*. There was no case where Pitocin was definitely known to be the causative factor until recently. In the last 5 years there had been 2 cases where Pitocin was involved. In one case it was the cause of the rupture and in the other it was a major factor in the rupture of a Caesarean section scar.

There was 1 case of unknown aetiology in the 1920–1929 period.

Maternal deaths. There were 35 deaths in 71 cases—a mortality of 50 per cent. The maternal mortality showed little change in the first 32 years under review. From 1940–1949 there were 2 deaths in 11 cases (18 per cent) and in the last 5 years 1 death in 12 cases (8 per cent).

Summary

Rupture of the uterus showed a peak incidence in 1930–1939 when traumatic deliveries and manœuvres were still being performed. At the same time operative trauma showed an increased incidence, and now operative trauma has replaced delivery trauma as the most frequent cause of uterine rupture. The maternal mortality remained high until the incidence of delivery trauma and natural trauma fell. As will be seen it is in these two types of cases that diagnosis is often delayed or absent.

Clinical Pathology

(1) *Delivery Trauma*. 23 cases.

Rupture occurring under this heading may include either primigravid or multigravid patients. Version was not nearly so frequent a cause in this series as in those recorded by other authors. In this series the striking feature was the high incidence of rupture associated with forceps operation. Attention is drawn to the high mortality in this type of case.

(2) *Natural Trauma*. 18 cases.

Causes: (*a*) Obstructed labour including hydrocephalus, brow and transverse lie.
(*b*) Uterine anomaly, angular pregnancy, concealed haemorrhage.
(*c*) Multiparity.

Three cases of spontaneous rupture occurred before labour in this series; one in association with concealed haemorrhage, one in a bicornuate uterus, and in one the cause was unknown.

Rupture occurred during labour in 7 cases of grand multiparae, and, of these, there were 2 cases of normal labour, 2 of prolonged labour, and 1 each of overaction, disproportion and breech. Six of the 7 died.

In nearly all cases of spontaneous rupture in a patient of gravid-4 and upwards, there was a history of either prolonged labour of several days in a previous pregnancy, or over-distension due to twins or hydramnios. Rupture does not usually occur immediately following the pregnancy or labour in which overstretching occurred. Four cases occurred in the 5 years 1950–1954, all giving a previous history of prolonged labour, twins or both and of these 2 had normal presentations, 1 was a brow and the other a breech.

(3) *Operative Trauma*. 28 cases.

The largest single cause in this group was previous classical Caesarean section. Of the 24 cases of Caesarean section scar rupture 20 were of a classical incision (including 1 classical hysterotomy) and 4 were ruptures of lower segment incisions.

Classical Caesarean section scar ruptures accounted for 28 per cent of the 71 cases in the 47-year period and for 38·5 per cent in the 30 years from 1924 when the first case occurred, and of the 4 lower segment Caesarean section ruptures 2 were incipient and 2 complete. One of the latter was associated with the use of a Pitocin drip after a failed surgical induction with recurrent disproportion present. In 2 of the cases of lower segment Caesarean section rupture, one incipient and one complete, there was an interesting factor present suggesting possible aetiology. In the incipient rupture localized pain and tenderness were present from the 35th week at the left side of the uterine scar. At the previous operation it was noted that great difficulty was experienced in controlling haemorrhage from sinuses at the left angle. In the other case of complete rupture the previous lower segment Caesarean section had been performed for an anterior placenta praevia. In both these cases with weak scars blood clot in the suture line must have prevented sound union. This might explain why some classical scars give way easily. If a normal delivery was to be risked after classical Caesarean section, it would be slightly safer if at the time of the Caesarean section the placenta had not been found to be situated anteriorly.

The 4 cases of previous operative trauma in which Caesarean section had not been performed were associated with previous curettage, myomectomy, the use of a Drew-Smythe catheter and manual removal of the placenta. The first of these patients had had a curettage performed 4 months after her first pregnancy. In the second pregnancy, labour commenced at the 36th week, and after 50 hours she collapsed, a complete rupture of the fundus being found at laparotomy. The second of these patients had had a normal delivery when 18 years old. At the age of 31 a myomectomy was performed and at the 34th week of her second pregnancy, 9 years after the myomectomy, the uterine scar ruptured.

The third patient had 5 normal pregnancies, but in the sixth the foetal heart ceased, and an attempt to rupture the membranes was made with a Drew-Smythe catheter. Later a laparotomy revealed a macerated foetus with placenta in the abdominal cavity, and a small perforation in the fundus of the uterus. In the 7th pregnancy labour began at the 32nd week and resulted in a rupture through the uterine fundus. The last of these 4 patients died after delivery of her 4th child. A manual removal of the placenta had been performed, and post-mortem an incomplete rupture was found, opening into underlying venous sinuses.

Cause of Death

Of the 34 deaths up to 1949, haemorrhage and shock accounted for 15 and sepsis for 14. Other causes were uraemia, intestinal obstruction and secondary haemorrhage. In the last 15 years 3 of the 23 patients with uterine rupture had died, and in each case the primary cause of death was failure in diagnosis.

Diagnosis

Nearly all writers emphasize the delay in the diagnosis of rupture of the uterus or threatened rupture. In this series of 71 cases there was delay in diagnosis in many cases, and in 17 the diagnosis was not made during life. Of these 17, 15 died after delivery and 2 died undelivered.

The diagnosis of ruptured uterus when dramatic is easy, and in this respect is not dissimilar to the diagnosis of frank rupture of a tubal pregnancy. There are many cases, however, in which the symptoms and signs are less startling and in these cases errors occur in diagnosis, or worse still, the signs are ignored as too trivial.

One moribund patient gave the best history: "I was in strong labour; the pains went; I went; there was a little bleeding and then continuous pain." Less dramatic cases may present a partial picture and it is in these cases that the possibility of uterine rupture must be kept in mind. In some cases there may be little or no vaginal bleeding, and sometimes unexplained sudden death of the foetus is the only sign. In other cases localized pain and a sudden rise in pulse rate may be the first evidence of trouble, and, above all, the occurrence of unexplained and continuing post-partum haemorrhage should call for immediate uterine exploration, with the possibility of rupture in mind. If there has been difficulty in delivery, haematuria of moderate degree should arouse suspicion.

Scar ruptures are often undramatic when severe internal haemorrhage is absent. What is not sufficiently appreciated is that in many cases warning of impending rupture may be present for some time when there is localized pain and tenderness over the scar.

Differential Diagnosis

Acute hydramnios and concealed haemorrhage may cause difficulty, also amniotic fluid embolism has caused an error in provisional diagnosis. A feature of this last condition is cyanosis.

Treatment

With the diagnosis made the patient stands a good chance of recovery. The essentials are blood transfusion and immediate laparotomy regardless of the state of shock of the patient. The aim in all cases of severe rupture should be to perform hysterectomy. If the tear is sutured the patient should be sterilized, and in those cases where no operation was performed death occurred usually from peritonitis.

Since 1950 there had been 12 cases of ruptured uterus in 8 of whom hysterectomy was performed with recovery. Two were classical scar ruptures, 1 for the second time, and 1 incipient classical scar rupture and 2 incipient lower segment scar ruptures were treated by repeat section, usually with sterilization. In classical scar ruptures hysterectomy is to be preferred since rupture in a succeeding pregnancy is likely. With lower segment scar incipient ruptures, repair may be adequate if a further pregnancy is desired.

Prevention

Classical Caesarean section and classical hysterotomy should be avoided. In the lower segment operation it may be unwise to separate the bladder down too far, as should rupture occur in a subsequent labour it may involve the bladder.

Difficult forceps deliveries, internal version and craniotomy should belong to a bygone era. There should be an increased awareness of the danger of rupture of the uterus in the multigravid patients, because of the greater frequency of malpresentations and larger babies. Emphasis should also be placed on the woman who has previously experienced over-distension of the uterus or a long labour, and hospital confinement should be insisted on for such multigravidae. Pitocin should not be employed after rupture of membranes and never after previous Caesarean section.

DISCUSSION

Mr. R. H. Corbet: There is no completely satisfactory classification of rupture of the pregnant uterus. The best is the division into (1) spontaneous rupture, (2) traumatic rupture, (3) rupture of scars.

Since 1923 Mr. Corbet had seen 39 cases of rupture of the uterus; 10 spontaneous, 18 traumatic, 11 rupture of scars. The site of rupture was in the upper segment in 9 cases, confined to the lower segment in 8 cases, and lateral wall tears involving both segments occurred in 22 cases. Eight of the 9 upper segment ruptures, and 3 of the 8 lower segment ruptures occurred through scars. Four patients were primigravidae and 35 multiparae.

Spontaneous rupture. This type is difficult to diagnose and may be impossible to treat. All 10 cases were multiparae in their 3rd to 11th pregnancies. In 2 cases there was disproportion due to hydrocephalus.

Spontaneous rupture usually occurs, if not silently, at least without the classical signs of threatened rupture. Many of the quoted signs: cessation of pains, recession of the presenting part and vaginal bleeding may be absent. Pains only cease if the foetus is delivered vaginally, extruded into the abdominal cavity, or the patient becomes profoundly shocked.

Recession of the presenting part occurs only if the greatest diameter has not passed the pelvic brim. In 4 of the 10 patients the presenting part was on the pelvic floor when uterine rupture occurred.

Vaginal bleeding was noted once. Bleeding may only be revealed after birth of the child or when the presenting part is disturbed. The most consistent sign was the rising pulse rate, and even that was absent once.

When there was disproportion it was easy to see why the uterus ruptured, but not when the head was deeply engaged. Injury in previous labours is not always borne out by histological examination of the edges of the rent.

Three of the 10 cases of spontaneous rupture died.

Rupture of scars. Six cases of rupture of upper segment Caesarean section scars; 3 cases of rupture of lower segment Caesarean section scars; 1 case of perforation; 1 case of rupture of myomectomy scar.

The indications for upper segment section are now very limited. The most dangerous and difficult to diagnose is the incomplete rupture of the upper segment scar. It usually occurs late in pregnancy, with vague increasing abdominal pain, tenderness over the scar and later signs of internal haemorrhage. Three of the 6 upper segment ruptures were of this type. In 2 of these cases both mother and baby survived.

The 3 lower segment scar ruptures occurred late in the first stage of labour. In 2 there were no signs of rupture, but unsatisfactory progress in labour led to laparotomy for Caesarean section when, in each case, a small hole was found in the lower segment behind the bladder. In the 3rd case all the conditions for vaginal delivery were fulfilled, yet the uterus ruptured late in the first stage.

Mr. Corbet suggested that once labour had started there is little difference in the risk of rupture between upper and lower segment scars, that the upper segment scar which remains intact after the first few pains will probably not rupture, and that the most dangerous time for the lower segment scar is towards the end of the first stage of labour.

Dr. R. T. Sears reported a case in which an accidental ante-partum haemorrhage clouded the diagnosis of ruptured lower segment Caesarean section scar. The patient had had 7 pregnancies, the 4th ending in Caesarean section for placenta praevia. In her 8th pregnancy accidental ante-partum haemorrhage occurred. She was delivered vaginally but collapsed and died 1½ hours after delivery with complete rupture of the scar.

Dr. R. Newton had twice seen rupture of the uterus due to hydatidiform mole and once due to placenta increta. He also had a case for whom operation was not undertaken, a gauze drain only being inserted, and he compared this method of treatment with Caesarean section in the early days when the incision was not sutured. He reported 2 other cases of ruptured uterus.

Mr. T. F. Redman mentioned a case in which cessation of uterine contractions and the foetal heart had led to the correct diagnosis.

Professor C. Scott Russell discussed the treatment of incomplete rupture. Operation was essential if the tear was at the side and involved a blood vessel, but he had seen a case of midline tear in whom no laparotomy was done and there had been complete recovery.

Dr. D. H. Blakey gave details of two cases—1 a fundal rupture, and the other a ruptured uterine horn.

Mr. P. C. Barkla had had a patient in whom everything went wrong. She was young, a primigravida, and the uterus ruptured at 32-weeks gestation for no apparent reason. The rupture was across the fundus anteriorly and after repair she did well. Later at laparotomy for an ectopic pregnancy the uterus looked normal.

Mr. C. G. Roworth had seen a similar case to that of Mr. Barkla. He removed the hole and she had since had a successful pregnancy. In another case a lateral tear was not sutured, and subsequently the patient had 3 abortions. At a later hysterectomy the tear was found along the whole length of the uterus.

Mr. F. Stabler distinguished between the cases of badly united scar and the true rupture. He had had a patient who required a Caesarean section at the 1st and 9th pregnancy. One part of the scar consisted of peritoneum only.

Dr. K. V. Bailey had published 3 cases of uterine scar rupture, and none had showed shock. He advised a semilunar incision for the lower segment.

Dr. F. Da Cunha had seen a case of rupture of a myomectomy scar at the 8th month of pregnancy. The patient felt something go. Caesarean hysterectomy was done and the baby lived.

Miss J. L. Hallum asked in how many cases the rupture was on the posterior wall. She had recently seen a patient who had had 11 previous pregnancies and in the last forceps had been applied and the urine was noticed to be blood-stained. In her 12th pregnancy labour had not progressed normally. There was slight vaginal bleeding. Later she collapsed and the foetal heart stopped. The tear was in the posterior wall, and hysterectomy was done.

Dr. J. M. Gate stressed again that the finding of haematuria might indicate uterine rupture involving the bladder.

Miss U. M. Lister had earlier this year reported 5 cases of spontaneous uterine rupture, the tear being in the posterior wall in 4. She thought repair of the tear and sterilization might be speedier and offer an alternative to hysterectomy in certain cases.

Mr. Dewhurst and Mr. Davidson replied.

DEUTSCHE GESELLSCHAFT FÜR GYNÄKOLOGIE

THE 31st meeting of the German Gynaecological Society will be held in Heidelberg from Tuesday, 18th September to Saturday, 22nd September, 1956. Requests for the Programme of the Congress and for other information should be addressed to the President, Professor Dr. Hans Runge, Univ.-Frauenklinik, Heidelberg.

BOOK REVIEWS

"Gynecology: Surgical Techniques." Compiled and edited by ROBERT J. LOWRIE, M.A., M.D., D.-OG., F.A.C.S., Associate Clinical Professor of Obstetrics and Gynecology, New York University. Pp. xx+ 523. Blackwell Scientific Publications, Oxford, 1955. Price £6 7*s*. 6*d*.

IN this large and handsome book, complementary to an earlier volume entitled *Gynecology: Diseases and Minor Surgery*, Dr. Lowrie has assembled 79 contributions on surgical techniques from 58 gynaecologists including 3 from Britain. The most striking feature is the presentation by several surgeons of their individual techniques for the same operation. Thus, for example, there are described 6 different operations for the cure of stress incontinence and there are 8 different accounts of varying types of hysterectomy. This novel idea would be even more valuable if the variations were critically compared and assessed, and this might well have been one of the functions of the editor, especially as his own contributions reveal a forthright mind and a pungent wit. The reader must perforce note for himself that a cure rate of about 90 per cent is claimed for each one of the techniques for relieving stress incontinence, and it is left to the authors of the Marshall-Marchetti operation to admit that their procedure is not perfect but that neither is any other perfect or permanent in effect. In this matter, however, Charles Read must be exculpated, for his description of the Millin sling operation is preceded by a well-argued comparison of the various methods of approach to the problem.

As might be expected, some of the contributors have been more successful than others in projecting their personality into their writing. Eminently successful in this respect is Chassar Moir, whose chapter on the closure of urinary fistulae is a model of clarity and authority. Another excellent contribution is by H. B. Atlee on the surgery of ectopic pregnancy. Almost every gynaecological operation (including one or two regarded as obsolete in this country) is described, and there is something to be learned from the small as well as the large. The treatment of a Bartholin's cyst by drainage and the construction of a new ostium and the technique for removing a cervical stump are as instructive in a way as the detailing of the radical operations of Meigs and Brunschwig. Yet the relative amount of space devoted to different procedures is not always well-balanced. Myomectomy is disposed of in less than 3 pages, and Victor Bonney's monograph is not included in the list of references to this operation or to ovarian cystectomy. On the other hand 20 pages are devoted to therapeutic sterilization. Paradoxically, in a book on gynaecological surgery, the longest chapter is on Caesarean section. Its inclusion is justified by the editor, who is also the author, as being "for the benefit of those whose remaining interest in obstetrics is in Caesarean section". This may not seem a cogent reason, but the result is a most excellent chapter —challenging, and even provocative as when it is argued that the proponents of the extraperitoneal routes were probably responsible for the acceptance and wider substitution of the transperitoneal approach; or that in the vast majority of properly selected cases and circumstances Caesarean hysterectomy carries no greater risk than Caesarean section.

The foreword to this book implies that the gestation period exceeded 10 years, but there are some signs that the delivery was a trifle precipitate. Misprints are surprisingly frequent for a work of this quality, proper names are mis-spelled (e.g., Isreal for Israel), illustrations and legends do not always tally (e.g., Fig. 2 on page 298), and there are notable omissions from the lists of references. Nevertheless Dr. Lowrie has achieved his object of producing a book that is different, and he has presented the gynaecologist with a valuable book of reference with illustrations of high standard.

"Cristalização do muco cervical (Crystallization of the Cervical Mucus)." By CARLOS ALBERTO SALVATORE. Pp. 127, 31 photomicrographs, 84 refs. José Ortiz, São Paulo, Brazil, 1954.

THIS is the publication of a thesis presented for the degree of Doctorate in Medicine in the University of São Paulo. An extensive review of the literature covering many aspects of the various properties of cervical secretion, including variations in its chemistry and response to hormones, is given first. Under the heading of Material and Method, a long series of biochemical experiments is carefully described to prove that sodium chlorate is present in the cervical secretion as well as mucin, and that by adding such reagents as silver nitrate, acetic acid, glacial acetic acid, etc., variations in the shape of the crystals are produced. The shape varies according to the stage of the menstrual cycle, pregnancy, etc.

The writer states that during the proliferative phase, crystallization of the cervical secretion produces a microscopical arborization arrangement of the crystals, and in his series of 31 photomicrographs, he shows several specimens of this type. Similar examination during the luteal phase or during pregnancy reveals a different design; here, the crystals are heaped together in fragments, and there is no evidence of arborization.

There is a summary of the clinical data of the 75 cases examined. The author claims to show that the crystallization of cervical secretion is due to the crystals of sodium chlorate, and that the pattern made by these crystals is determined by the physico-chemical state of the mucin, which, in its turn, is influenced by the presence or absence of progesterone in the body.

From the clinical aspect, examination of a drop of cervical secretion allowed to dry on a slide at room

temperature for 24 hours, can be used as a test for diagnosing the presence of the luteal phase or of pregnancy. If the specimen shows a mixture of the arborization design and a massing of the crystal fragments, ovulation at that time is presumed.

The publishers are to be congratulated upon the high standard of printing, photography and paper, but any reader who wishes to study the biochemistry may experience difficulty in following the various reactions, unless he is familiar with Portuguese chemical nomenclature.

"No Time for Fear." By GRANTLY DICK READ, M.A., M.D. Pp. 235+xi. Illustrated. William Heinemann, London, 1955. Price 21*s*.

THIS book recounts the adventure and misadventures of the Dick Read family on a caravan tour through Central Africa. One is sure to admire Mrs. Dick Read's driving of a 6-ton vehicle over some very bad roads. The narrative is filled out with reflections on African politics, medicine, wild life, race relations and so on. Some of the author's views are surprisingly militant ("There would be peace in Kenya today if the Masai had been allowed to give their well-tried medicine to Kikuyu renegades") but he is more usually on the side of the angels, though dubious about missionaries and respectful towards witch doctors.

However, Africa was toured not merely for the fun of it but, "to learn of normal childbirth in its natural environment, and whilst doing so to find out the cause of troubles when they arose and how they might be remedied"; not in a humble spirit of scientific curiosity, but because "For over forty years I had suspected the beliefs of my medical colleagues; I suspected them of misinterpreting the laws of nature, and implementing modern scientific methods to hide not only the pain of childbirth but their failure to understand its cause. After long years of loneliness in my investigations of the natural law, I satisfied myself that the physiological and anatomical apparatus the Creator had evolved for childbearing women was a magnificent manifestation of Divine genius. If its activities during pregnancy and labour could be protected from the misconstructions of obstetric orthodoxy, then women and children would find a new joy in living and a new standard of health."

The orthodox obstetrician who feels guilty after digesting this indictment, and reads on expecting enlightenment, will be disappointed. Childbirth in the African is described factually in only about a dozen short passages; for example: "Their customs do not allow the acts and interferences which account for over sixty per cent of maternal morbidity in the white man's countries. Their errors are tragedies, for their attendants have not the knowledge or ability to understand or treat irregularities, but between ninety-four and ninety-eight per cent in different tribes have normal natural births and no more convalescence than a few hours' rest, if need be, after the event." Prolonged labour is usually considered by the African to be evidence of adultery, and may end in rapid delivery when the woman confesses the names of her lovers. This "appears to me to be quite rational when the fear-tension-pain syndrome of labour is applied. These women are afraid to see the baby for many reasons. We know that fear causes resistance to birth and that in turn causes pain. Confession removes the fear and the resistant birth canal is relaxed."

The scientific results of the quest are negligible. Even though Dr. Dick Read hopes in time to sort and tabulate his data, he indicates that there is little more to say. This is not surprising; it is far from easy to penetrate the minds and customs of remote and primitive peoples, let alone to collect reliable vital statistics about them, and it cannot be done while flitting from place to place in a caravan.

"Annual Report on the Results of Treatment in Carcinoma of the Uterus." Edited by J. HEYMAN. Statements of Results obtained in 1948 and previous years. Tenth Volume. Collated in 1954. Pp. 345. Editorial Office: Radiumhemmet, Stockholm, 1955.

IN the present Report statements on carcinoma of the cervix have been contributed by 84 institutions (that is 12 more than in the previous Report), concerning 102,614 cases from 20 different countries. Statements on carcinoma of the corpus were submitted by 27 collaborators from 10 countries covering 8,366 cases. Statements on *carcinoma corporis et endocervicis*, *carcinoma uteri et ovarii* and *carcinoma pelvis* were collected from 18 centres reporting on 921 cases.

Part I of the Report deals with carcinoma of the cervix, presenting the material according to stages.

Of the 84 collaborating institutions, 34 reported on 607 cases of Stage O cancer examined in 1948 and previous years, but 27 of these gave information on odd cases only. Consequently, the material of only 7 collaborators supplying 495 cases is discussed. This means an increase of 318 cases as compared with the Ninth Volume of the Report. Of these 495 patients 384 were treated, 264 by hysterectomy, 83 by radiotherapy and 37 by other forms of therapy.

Comparing the figures from various institutions one is struck by the large proportion of cases allotted to Stage O. Doubt is cast on the reliability of classification and diagnosis. A definition of Stage O by a representative international committee is recommended.

The editors have made an excellent survey, based on the very large material presented in the present Report, of some of the avoidable sources of error in therapeutic cancer statistics which are still not generally sufficiently appreciated.

When all the data in the statements are combined, information concerning 102,614 cases of cervical cancer is provided, of whom 95,813 (93·4 per cent) were treated. Comparing the results of radiotherapy between the latest 5 years and previous years a steady improvement in the relative 5-year apparent recovery rate is noticeable. In Stage I the relative apparent recovery rate increased from 61·3 per cent in previous years to 64 per cent in the last 5 years, in Stage II from 42·2 per cent to 46 per cent, Stage III from 23·6 per cent to 26 per cent and in Stage IV from 6·6 per cent to 7 per cent. The overall relative apparent recovery rate of 35·3 per cent in this Report is the highest yet presented in this series, corresponding

percentage figures from previous years being 26·2 (Vol. 2), 27·6 (Vol. 3), 26·7 (Vol. 4), 30·9 (Vol. 5), 31·8 (Vol. 6), 32·6 (Vol. 7), 34·1 (Vol. 8) and 34·7 (Vol. 9). The improvement in results obtained seems to be mainly due to greater efficiency in treatment.

Surgical treatment of cervical cancer with or without pre-operative irradiation comprised a total of 2,454 cases. Unfortunately, no reliable comparison between surgical and irradiation treatment could be carried out on the presented material, but 5-year results from institutions favouring primary surgery in selected cases seem to be slightly worse than those of institutions favouring primary radiotherapy, the figures being 62·9 per cent for Stage I and 42·9 per cent for Stage II as compared with 65·9 per cent and 47·4 per cent respectively. The conclusion is therefore made that there is no need for primary surgery where adequate radiotherapy is available.

Part II of the Report deals with cancer of the uterine body. Only 27 of the 84 collaborators submitted reports on carcinoma of the corpus, including a total of 8,366 cases of invasive cancer, of which 8,076 (96·5 per cent) received treatment. The relative apparent recovery rate was 69 per cent in Stage I, Group 1; 46 per cent in Stage I, Group 2; and 19·6 per cent in Stage II.

Comparing overall results of primary surgery (2,405 cases) with primary radiotherapy (2,811 cases), it appears that the 5-year surgical salvage rate is slightly better than that for radiotherapy, the figures being 57 and 53 per cent respectively. If only Stage I cases are considered, the figures are 63·4 per cent after primary surgery and 58·4 per cent after primary radiotherapy.

Part III is devoted to *carcinoma corporis et endocervicis*, *carcinoma uteri et ovarii* and *carcinoma pelvis*. The presented material comes from 18 of the 27 observers reporting on *carcinoma corporis* and is too small to allow of general conclusions.

Finally, the Report presents a table with a survey of the distribution of all cases examined by institutions reporting on all groups of uterine carcinoma. Of 30,092 cases of uterine cancer reported between 1928 and 1948 77·5 per cent were cancer of the cervix, 19·6 per cent cancer of the body and 2·9 per cent other sites. Comparing the figures of the individual collaborators with the corresponding figures in the Ninth Report, it appears that the incidence of cancer of the body is on the increase.

The Tenth Report is as admirably compiled as its nine predecessors. It provides a wealth of interesting data in an impressive and clear manner and is a unique source of information on gynaecological cancer.

Erica Wachtel

"Lehrbuch der Geburtshilfe." By H. MARTIUS, with the co-operation of W. BICKENBACH and MISS K. DROYSEN (artist). Third edition. Pp. 789, illustrations 777. Georg Thieme, Stuttgart, 1956. Price DM59.70.

THE outstanding qualities of this textbook of Obstetrics are clarity and beauty. The lucidity of the presentation throughout, particularly that of the mechanics of normal and abnormal birth, cannot conceivably be surpassed. Biographical and etymological footnotes enliven the text. The illustrations are a pleasure to behold. Not a few of them, like those dealing with the early development and the nidation of the zygote, are masterpieces. Some figures and tables, such as the two figures depicting the impossibility of spontaneous delivery in mento-posterior face presentation, are worth pages of text, and must be unique.

The plan of the book is orthodox: (*i*) Pregnancy, (*ii*) Delivery, (*iii*) Multiple pregnancy and birth, (*iv*) Puerperium, (*v*) Lactation, (*vi*) Obstetric paediatrics, (*vii*) Reproductive hygiene. Each of these chapters is subdivided into a physiological and a pathological section. Operative procedures are excluded; they are dealt with in a separate volume. Such an arrangement, while preventing undue bulk, at times mars the continuity of description of treatment.

The tenor of the book is conservatism. However, although procedures such as application of leeches and ointments for deep femoral thrombosis, the injection of cardiazole and strophantin for post-partum shock, the intramuscular injection of camphor in oil in puerperal septicaemia are recommended, modern treatment with antibiotics is fully described. Sheehan's syndrome is mentioned, and Grantly Dick Read's "natural childbirth" is several times referred to. (The latter term is not translated into German, but used in its English form.)

The next edition of the book will probably include other conditions which have come into prominence in recent years, among them amniotic fluid embolism, hyaline membrane, fibrinogenopenia, the modern notion and treatment of obstetric anuria. This remark is not meant to—nor could it possibly—detract from the value of this grand book by a truly great teacher.

REVIEW OF CURRENT LITERATURE

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PREGNANCY

1. **Physiotherapy and its Effect on Respiration in Pregnancy and the Puerperium.** (Physiothérapie et fonction respiratoire au cours de l'état gravido-puerpéral.)

By H. PIGEAUD, A. NOTTER, F. CHARVET and C. KADI. *Gynéc. Obstét.*, **54**, 175–179. 1955. 3 tables. 16 refs.

The writers studied 255 cases to consider the influence of psychotherapy and physiotherapy in late pregnancy on the respiratory capacity during labour. This was shown to be greatly increased. They also studied the influence of altered respiratory rhythm on the course of labour and the effects of inhaling oxygen during the second stage. One hundred and seventy pregnant women were investigated and the results analyzed, using a spirometer. A gain of 30 per cent in their vital capacity was found and a 90 per cent increase in the duration of voluntary apnoea in forced inspiration during the period of expulsion. The confinement was rendered easier in 75 per cent of primigravidae by voluntary variation in the rhythm and techniques of respiration (thoracic, abdominal or bronchial) and also by improvement in maternal oxygenation.

D. Maxwell

2. **Basal-cell Hyperactivity of the Cervix in Pregnancy with Post-partum Follow-up.**

By R. E. L. NESBITT. *Obstet. Gynec.*, **6**, 239–253. Sept. 1955. 52 refs.

During 6½ years at Johns Hopkins Hospital 1,910 cervical biopsies were taken on the obstetric service. The abnormal cases, excluding 7 cases of intraepithelial carcinoma, comprise the material for this report. The biopsy incidence of basal-cell hyperactivity was 17·3 per cent. There were 255 patients with 330 biopsies showing this cervical lesion. The importance of the lesion is that it may be confused with intraepithelial carcinoma. Cases with basal-cell hyperactivity during pregnancy have a 77·4 per cent chance of reverting to normal by 6 weeks post-partum, and 94·1 per cent are normal by the sixth month post-partum. There is an apparent increase in the incidence of basal-cell hyperactivity in subsequent pregnancies according to the grade of hyperactivity in the initial pregnancy.

None of the cases in this report developed pre-invasive or invasive carcinoma, although the hyperactivity was persistent in 8 cases for variable lengths of time up to 30 months.

However, cases that demonstrate the capacity to produce advanced hyperactive change in the cervix under the influence of pregnancy may constitute the group that ultimately develop cervical cancer.

J. G. Dumoulin

3. **Evaluation of the Rat Hyperaemia Test for Pregnancy Diagnosis.**

By S. D. ELEK. *Brit. med. J.*, **2**, 600–602. Sept. 3, 1955. 24 refs.

Immature female rats withstand toxic urines better than mice and their ovaries show an easily recognizable

hyperaemia in response to gonadotrophin. Positive results may be obtained 2 hours after subcutaneous injection or one hour after intravenous injection but an interval of 6 to 18 or 24 hours leads to greater accuracy. Both false-positive and false-negative results are reported in the literature.

The present investigations involved 227 known pregnant and 55 non-pregnant individuals. Two ml. of untreated early morning urine was injected subcutaneously into female rats 3 to 6 weeks old (Wistar No. 1 strain) and readings were taken 18 hours later. The ovaries were examined immediately after opening the abdomen—the animal being alive but anaesthetized—and the colour compared with that of the Fallopian tubes against the peritoneum of the abdominal wall. The normal ovary is dull, waxy and yellow. The effect of gonadotrophin is to cause varying degrees of hyperaemia and some swelling. The reading requires practice and good light—fluorescent light is unsatisfactory. False-positive readings may result from delay in examining the ovaries which turn pink on exposure to air and may also be obtained if the patient has been treated with penicillin. Death of the animal prior to the reading, and exsanguination may lead to false negative results. If all the abdominal organs are inflamed, satisfactory readings cannot be taken.

Using a single rat per specimen the series showed a false-negative rate of 7 per cent and a false-positive rate of 7·3 per cent. Two hundred and four of the specimens were also examined by the Hogben test. The "one-rat" test showed a slightly greater number of correct positives than the toad test, but gave 10 per cent false-positives whereas the latter showed none.

The single-rat test is therefore unsuitable for clinical purposes but the author shows that by increasing the number of test animals, any desired degree of accuracy can be obtained.

R. W. Grayburn

4. **Inadequacies of Frog Pregnancy Test.**

By P. H. FRIED and A. E. RAKOFF. *Obstet. Gynec.*, **6**, 12–17. July 1955. 27 refs.

In 1947 Galli-Mainini described enthusiastically results using the male Batrachia pregnancy test, which was based on the release of spermatozoa into the animal's urinary tract by the injected chorionic gonadotrophin.

The authors evaluate the test in a series of 189 urine specimens and compare it with the 3-hour rat ovary hyperaemia pregnancy test which was also done on the same specimens. Since the male frog and male toad have been reported to be of equal value, male *Rana pipiens* were used. The tests were done during winter and spring since the sensitivity is less in summer.

The accuracy of the male frog test was 83 per cent for the 189 women of whom 60 were not pregnant. The results of the rat ovary hyperaemia test were correct in 98·4 per cent. The male frog test was most accurate (92 per cent) in the pregnant cases tested in the latter part of the first trimester, which is the period of peak chorionic gonadotrophin levels.

The response of the male frogs to different amounts of commercially available chorionic gonadotrophin showed that the minimal effective dose for a positive reaction was 12 International Units. During the summer months this was 20. In comparison the figure for the rat test was 0·6, and this was reduced to 0·3 by the addition of a pituitary synergist. In the positive frog test sperms were obvious in 2–3 hours.

These findings suggest that the male frog pregnancy test is not an acceptable procedure for the average laboratory owing to the lack of animal sensitivity to chorionic gonadotrophin. This is particularly so when used during the last two trimesters of pregnancy and as a test for intra-uterine death or abortion.

J. G. Dumoulin

5. **Prolonged Pregnancy.**

By G. B. GIBSON. *Brit. med. J.*, **2**, 715–719. Sept. 17, 1955. 35 refs.

Prolonged pregnancy may be defined as a pregnancy which continues for more than 14 days after the expected date of confinement provided that the estimation of this date is accurate.

In order to discover the incidence of prolonged pregnancy and the pathological significance of the condition, the author personally interviewed 5,000 consecutive patients during the first week of the puerperium. Postmaturity occurred in 7·4 per cent of 4,389 patients who commenced in labour spontaneously with a single vertex presentation. In 53·1 per cent of these women labour occurred spontaneously during the 40th or 41st week of pregnancy. No relationship between the length of the menstrual cycle and the duration of pregnancy was found, except when the cycle was unduly prolonged.

Foetal deaths (including neonatal deaths within 12 hours of birth) were found to be minimal when labour started during the 41st and 42nd weeks—the figures being 2·1 per cent and 1·9 per cent respectively. There was a double increase in the 43rd week and a triple increase subsequently. The majority of these deaths have no obvious cause. Reference elsewhere indicates that the main risk occurs during the first and second stages of such labours and that deaths are due to anoxia *in utero*.

The assessment of a suspected case of postmaturity may be difficult and the various factors which may aid one in coming to a decision are enumerated.

As regards the treatment of postmaturity, both medical and surgical induction of labour are condemned. It is thought that the former is only successful if labour is about to start in any case, and that the latter procedure, though potentially dangerous, has no clear advantage. The author advocates "masterly inactivity" until labour starts spontaneously. He recommends also that these confinements be conducted in a hospital where there are facilities for immediate delivery by forceps or by Caesarean section should foetal distress ensue. The strictest watch for foetal distress must be maintained.

R. W. Grayburn

6. **Emesis Gravidarum.**

By H. P. WAGER. *Obstet. Gynec.*, **6**, 99–106. July 1955. 49 refs.

The author reviews the literature on the aetiology and

mechanism of vomiting in pregnancy. For its control, he reports on the use of tablets made up as follows:

Phenobarbital 10·8 mg., sodium pentobarbital 10·8 mg., scopolamine aminoxide hydrobromide 0·25 mg., atropine aminoxide hydrochloride 0·25 mg., procaine hydrochloride 150 mg., pyridoxine hydrochloride 10 mg., aluminium hydroxide dried gel 250 mg.

The procaine is thought to anaesthetize the gastric mucosa, decreasing local irritability. Scopolamine depresses cerebral irritability, while atropine prevents parasympathetic overstimulation and gastric hypersecretion. The barbiturates have a central depressing action. Aluminium hydroxide is included to relieve gastric hyperacidity.

The dose of the tablets used was one 3 or 4 times a day, and 309 cases were treated. Complete remission of symptoms was reported in 81 per cent, vomiting ceased but nausea continued in 8 per cent, whilst 11 per cent showed no improvement.

J. G. Dumoulin

7. Toxemia of Pregnancy at the Charity Hospital in New Orleans.

By J. H. Ferguson and H. K. Miller. *Surg. Gynec. Obstet.*, **101**, 257–268. Sept. 1955. 1 fig. 28 refs.

A review of the hospital records of all women who were delivered on the Tulane Service of the Charity Hospital at Louisiana, at New Orleans, in the year 1950, has been made in an attempt to define the problem of toxaemia of pregnancy as it exists at that hospital. The patients were drawn from the poorer people of the State of Louisiana, 82 per cent were negroes. Their diets have been found to be about the poorest recorded in the United States; 45 per cent had no milk, 31 per cent no meat and 28 per cent no vegetables or fruit. Attendance at the clinics was not good.

Each case of toxaemia was assigned to one of the following sub-groups which are defined in detail:

(1) Pre-eclampsia.
(2) Eclampsia.
(3) Chronic hypertensive disease.
(4) Chronic hypertensive disease with superimposed pre-eclampsia.
(5) Unclassified.

During 1950, 3,899 mothers were delivered on the Tulane Service and of these 736, or 19 per cent, had toxaemia. There was no evidence that this high incidence was the result of the large coloured census.

Pre-eclampsia

Three hundred and forty-nine, or 47 per cent, of the toxaemic patients had pre-eclampsia with a stillbirth rate of 3·6 per cent and a peri-natal death rate of 4·8 per cent. Treatment was generally conservative with bed rest and sedation. Phenobarbital was the drug most often used. Labour was induced in only 7 per cent.

Eclampsia

There were 10 cases of eclampsia, with no maternal death and only one stillbirth. Treatment consisted mainly of sedation, but tracheotomy was performed on one patient with respiratory embarrassment.

Chronic Hypertension

Three hundred and forty-seven, or 47 per cent, of the toxaemia patients had chronic hypertensive disease and of these 167, or 48 per cent, developed superimposed pre-eclampsia. In this whole group the peri-natal death rate was 11·8 per cent. Treatment once again was mainly conservative.

Unclassified

There were 30 patients in this group, although they suffered from toxaemia, they could not be accurately catalogued under the other headings.

In the whole series the stillbirth rate was 6·5 per cent and the peri-natal mortality rate 9·2 per cent. It is interesting to note that chronic hypertensive disease was considerably more lethal for the foetus than the acute forms of toxaemia. There was one maternal death. This patient had chronic hypertensive disease and had a pulmonary embolism after Caesarean hysterectomy.

Labour was induced in only 65 women. Pitocin infusion was the most popular form of induction and was used in 38 instances. No adverse effect on toxaemia has been observed following the administration of pitocin.

John P. Erskine

8. Toxemia of Pregnancy as an Etiological Factor in Hypertensive Vascular Disease.

By P. C. Schreier, J. Q. Adams, H. B. Turner and M. J. Smith. *J. Amer. med. Ass.*, **159**, 105–109. Sept. 10, 1955. 18 refs.

In spite of the confusion that surrounds this subject the authors consider that the evidence in favour of the theory that toxaemia of pregnancy leads to permanent hypertension is considerably greater than the evidence to the contrary. After reviewing the literature the authors record details of 239 patients (95 per cent of whom were Negroes) who were followed up for periods of 5 and 10 years at the University of Tennessee and the City of Memphis Hospitals. Only primigravidae with normal blood pressures in early pregnancy were selected, and the number of pregnancies and the incidence of repeated toxaemia were correlated with age and the finding of persistent hypertension.

A high percentage of patients suffered from recurrent toxaemia and 11·3 per cent of the total were found to have permanent hypertensive disease. This is higher than the incidence of hypertensive disease in women of similar age selected at random from industry, which is quoted as 8·4 per cent (a figure obtained by Master in a study of 7,000 women). It is concluded therefore that toxaemia of pregnancy results in an increased incidence of hypertensive disease and that the more severe the initial illness, excluding eclampsia, the more likely there is to be permanent vascular damage.

D. W. James

9. Peripheral Utilisation of Glucose in Pregnancy.

By R. L. Burt and C. A. Kimel. *Obstet. Gynec.*, **6**, 51–54. July 1955. 19 refs.

In a previous report the authors described the response of the plasma inorganic phosphorus concentration to

intravenous glucose administration in normal pregnancy and puerperium. Although glucose "tolerance" was not found to be significantly altered by gestation, attenuation of the inorganic phosphorus response to glucose loading was characteristic of the pregnant and early post-partum state.

In this report 13 cases of acute toxaemia of pregnancy are studied. A consistent decrease in "tolerance" to intravenously administered glucose is found. The plasma inorganic phosphorus response to glucose loading was not changed. The authors believe that these findings may be related to altered hepatic function in acute toxaemia.

J. G. Dumoulin

10. **Control of the Initial Pre-eclamptic Sign.**

By H. M. CAREY. *N.Z. med. J.*, **54**, 377–390. June 1955. 2 tables. 5 figs. 22 refs.

This is a paper presented at the first New Zealand Congress of Obstetrics and Gynaecology. Having defined pre-eclampsia and mentioned its aetiology, the author begins his thesis that the only factor in the control of pre-eclampsia which can be attacked is the sodium level. The other facets of the biochemical pathology are outside the reach of present day therapy. In a hospital equipped with an adequate diet kitchen the salt content of the food can be reduced to 2 g. daily. Until this level is reached, success in retarding the development of pre-eclampsia will not be obtained. Elevation of the feet to reduce venous pressure and facilitate reabsorption of extracellular fluid stimulates sodium excretion. Bed rest, therefore, allows improvement of the condition. Administration of ammonium chloride stimulates increased sodium excretion for the first 48 hours. When ammonium chloride is given it should be given intermittently. Diamox increases the sodium excretion but also increases the potassium excretion so its administration should also be intermittent. The use of ion exchange resins is given in detail, with some explanatory figures. The author considers that resin administration is indicated in cases with moderate or marked oedema or with poor urinary output. Resins are particularly valuable in treating these signs if they develop before the 36th week of gestation.

The discussion was opened by R. McK. Rome. All patients with water retention should not be regarded as pre-eclamptic. Diet should be investigated carefully and in some cases correction of protein intake or haemoglobin levels produces a rapid return to normal. If the weight gain is attributable to toxaemia, the following measures are undertaken at the Royal Women's Hospital, Melbourne. Bed rest with mild sedation, elimination in the more severe cases and ammonium chloride in short courses of 2–3 days. Exchange resins have not been popular and infusion of hypertonic glucose solutions has been abandoned.

Albuminuria, although a late sign of toxaemia, is a most important one. It is a rule in the author's clinic that, once a patient has developed albuminuria of any amount and it is regarded as toxaemic in origin, she is not permitted to leave hospital until the baby is delivered. Of 14 antenatal patients who died of eclampsia, no fewer than 10 had a trace or more of albumen and after treatment were allowed to return home.

J. L. Wright, continuing the discussion, gave the results of treatment of toxaemia with hypotensive drugs. In Dunedin, hexamethonium bromide and pentamethylene-pyrollidinium bitartrate (M. & B. 2050A) have been used. The pregnant woman is very susceptible to these drugs and it is necessary to use smaller initial and incremental doses than those recommended for non-pregnant patients. The aim of treatment is to lower the blood pressure to about 140 systolic and 90 diastolic, gross falls being avoided due to the risk of serious effects on the foetus by aitering the placental circulation. Treatment has been given to the following groups of patients: severe pre-eclamptic toxaemia; eclampsia; and cases of residual hypertension which persist after previous toxaemic pregnancies. The results of treatment in cases of severe pre-eclampsia have been disappointing. Although the blood pressure was lowered, the foetal mortality remained high. One case of eclampsia was treated and in this case control of fits was satisfactory and time was allowed for the institution of other measures and the induction of labour. Cases of residual hypertension were more encouraging in their results. The writer suggested that this is the most suitable and logical method of employing hypotensive drugs in a prophylactic manner. Adequate rest and salt restriction are also enforced.

L. Woodrow Cox

11. **Use of Hypotensive Agents in Treatment of Pre-eclamptic Toxaemia of Pregnancy.**

By R. R. DE ALVAREZ. *Obstet. Gynec.*, **6**, 55–62. July 1955. 22 refs.

In 21 pre-eclamptic patients studies were made of glomerular filtration rates in the kidney using inulin, while renal plasma flow was determined utilizing para-amino hippurate. In addition, the influence on urinary sodium concentration and tubular rejection fraction of sodium was studied. Urinary output and blood pressure reaction were noted. Fourteen patients were given intravenous Protoveratrine, an alkaloid of veratrum viride, four 1-hydrazinophthalazine (Apresoline) and the remaining three a reserpine alkaloid (Serpasil).

Protoveratrine caused a drop in the systolic blood pressure only in those cases with benign hypertension and superimposed pre-eclampsia, but in all cases the diastolic pressure fell. Apresoline produced sudden drops in both systolic and diastolic pressures. Serpasil when given in a large enough dose had an action similar to Apresoline.

A slight increase in glomerular filtration rate was produced using protoveratrine. There was a greater influence on renal plasma flow. However, urinary output was decreased markedly with a concentration of urinary sodium excretion. There was a marked difference in response depending on whether the pre-eclampsia was superimposed on benign hypertension or not. Apresoline enhanced urine secretion and caused a decrease in urine sodium concentration. Serpasil caused little increase in the glomerular filtration rate and a pronounced increase

in renal plasma flow; a decrease in urinary output occurred with increased urine sodium concentration.

J. G. Dumoulin

12. **Treatment of Eclampsia and Pre-eclampsia with Hypotensives.** (I. Ulteriore contributo alla terapia ipotensiva della sindrome eclamptica e dello stato pre-eclamptico: i derivati idroftalazinici.)

By A. Cossutta. *Minerva ginec., Torino*, **7**, 533–542. Aug. 15, 1955. 31 refs.

(II. Sull' impiego dell' 1-4-deidrazinoftalazina e della reserpina nella prevenzione e nella cura delle gestosi tardive.)

By G. P. Balassi and P. M. Possi. Pp. 542–549. 80 refs.

These two papers relate experiences in the treatment of eclampsia, pre-eclampsia and of essential hypertension in pregnancy with ganglioplegics, with rauwolfia preparations and with the newer derivatives of phthalazine. Each class was used separately or in association with the others in various combinations and under different indications. The general conclusion was that better results were obtained by a combination or sequence of the drugs, and the authors emphasize the especial value of the rauwolfia preparations in calming the patient and slowing down the heart beat. The conditions treated are serious or severe and the treatment is not without risks and inconveniences, nor are the results uniform though they are encouraging.

W. C. Spackman

13. **Experimental Eclampsia.** (L'éclampsie expérimentale.)

By V. Dekanic-Milosevic and S. Marinkov. *Gynéc. Obstét.*, **54**, 218–226. 1955. 5 figs. 42 refs.

The authors put forward a new hypothesis concerning the aetiology of eclampsia, and have endeavoured to show experimental proof of this in living bitches. The animals were put on a high salt and protein diet and also given injections of predigested proteins. During the experiments the body weight, plasma protein concentration, blood pressure, white cell count, and urine were examined at regular intervals. At the end of the experiment, the organs of the dogs were submitted to histological examination.

Their hypothesis is as follows: The various maternal and foetal exchanges across the placental barrier and, above all, the anabolistic and katabolistic foetal protein substances, can result in the formation of toxic substances to the mother. These rejected substances arrive in the mother's general circulation and, avoiding the liver as a filter, can produce capillary lesions which represent the initial changes in cases of eclampsia. Four pregnant bitches were used and four non-pregnant bitches acted as controls. The experiments were begun at the 6th week of the pregnancy in each case, which corresponds fairly well to the third month of human pregnancy. The intravenous predigested proteins used were, peptones, aminoacids, tyrosine, cystine, cysteine, tryptophane and leucin. The animals received from 2–30 ml. of the protein digest daily by intravenous route.

D. Maxwell

14. **The Influence of Novocaine, Phenergan, Largactil and Hyaluronidase in Pre-eclamptic Toxaemia and Eclampsia.** (L'influence de la novocaïne, du phénergan, du largactil et de l'hyaluronidase sur l'éclampsisme et l'éclampsie.)

By N. C. Louros, E. Hatji-Emmanuel, D. Kaskarelis, D. Maroudis and A. Gouscos. *Gynéc. Obstét.*, **54**, 209–217. 1955. 4 figs. 1 table. 25 refs.

In the authors' opinion the following have given good results in the treatment of pre-eclamptic toxaemia and eclampsia:

(1) Bilateral infiltration of the lumbar sympathetic ganglia with novocaine greatly reduced the blood pressure in 50 out of 61 cases (81·9 per cent).

(2) Phenergan was used in 23 cases of pre-eclampsia and eclampsia, 8 in pregnancy and 15 during labour. In 19 (69·5 per cent) there was a gross fall in the blood pressure. Coincidently the output of urine was increased and the body weight was reduced.

(3) The giving of a "cocktail" including largactil, phenergan, pethidine and oresthine reduced the blood pressure and also accelerated the speed of labour in 9 cases out of 10.

(4) The use of hyaluronidase caused the disappearance of severe oedema in 12 out of 15 cases in the space of a few days.

D. Maxwell

15. **Placenta Circumvallata and Placenta Marginata.**

By N. Torpin. *Obstet. Gynec.*, **6**, 277–282. Sept. 1955. 13 refs.

The author considers that the aetiological factor in placenta circumvallata and marginata is excessive implantation of the fertilized ovum into the endometrium (decidua) so that the early placenta covers more than half the foetal sac. The contents then herniate out of the cavity, at the same time dilating the membranes which cover the remainder of the sac. The amniotic membrane dilates gradually and the foetus and amniotic fluid emerge into the distending amniotic sac while the excess placental tissue on the periphery is withdrawn from the uterine wall by separation through the sheet of decidua. The detached rim of placenta slowly atrophies and is pushed back onto the face of the active placenta.

It is probable that many abortions are the result of placental anomalies of this nature.

J. G. Dumoulin

16. **Heart Disease in Pregnancy.** (Il rischio delle cardiopatie in gravidanza.)

By P. N. Siliquini and E. Revelli. *Minerva ginec., Torino*, **7**, 454–482. July 31, 1955. 7 tables. 11 figs. 60 refs.

The authors point out that there are three separate risks to be considered when pregnancy occurs in a patient with a diseased heart. Firstly, the ordinary risk of the heart disease itself progressing or relapsing just as it might in the non-pregnant. Secondly, there is the specific strain thrown on a diseased heart by a normal pregnancy, and, thirdly, the aggravated risk added by an abnormal (toxaemic) pregnancy on a damaged heart. In

a consideration of their own 117 cases they estimate these risks as 5 per cent, 79 per cent and 16 per cent respectively. Failure of compensation occurred in 46 cases, being severe in 13. Of these severe failures, only 7 were among the 97 cases of "ordinary" and "specific" risk mentioned above, whilst 6 were among the 19 patients with toxaemia. Eight of the severe failures occurred during pregnancy, 3 during labour, and 2 shortly following the labour. Five of the women died, 1 before labour, 3 during or immediately after delivery, and 1 in the puerperium. The incidence of heart disease among total admissions for delivery was about 1 per cent and mortality 4·2 per cent of the heart cases. The prognosis was worst where valvular lesions were associated with myocarditis, as one would expect.

In the management of these pregnant cardiacs, and their study and control, they have consistently adopted a close collaboration between obstetrician and cardiologist even to the establishment of special centres for handling them.

The paper gives a good account of the haemodynamics of pregnancy, it being necessary to have a clear picture of the effects of pregnancy on the healthy heart and circulation, and reference is made to recent work on cardiac output as revealed by catheterization methods. They refer to work which appears to show that the cardiac output increases during the 5th, 6th and 7th months of normal pregnancy and then tends to fall again to full term.

Treatment. When failure of compensation began to show itself, treatment did not follow any fixed scheme, but each case was treated on its individual merits and needs, it being found that much guidance was afforded if the case had been seen before failure of compensation began to develop. Such cases were immediately admitted for full investigation, but so far as possible rest and reassurance were relied upon and the patients were psychologically buoyed up and encouraged with the aim of bringing them to labour in the best possible frame of mind and body; at the same time digitalin, oxygen and other pharmacological and physical treatment was ordered as indicated for the individual case. Valvulotomy was not carried out in any case but is not discarded. This measure was first suggested by Sir Lauder Brunton in 1902, but abandoned owing to its understandably bad results at that epoch. Therapeutic abortion was done 4 times, whilst 2 aborted spontaneously; in 8 labour was induced before term. At term, forceps were used in not quite half the cases, and 3 were delivered by Caesarean section, 1 for a primipara, 1 for pelvic contraction and 1 for vaginal stenosis. In all cases showing evidence of failure of compensation (pulmonary oedema, dyspnoea), great stress is laid on giving oxygen. The condition of the heart can be effectively watched by the electrocardiograph which quickly shows alterations in the tracings due to anoxia. In labour, no advantage is claimed for any one system of anaesthesia. A highly skilled anaesthetist is presupposed and hypotensive drugs avoided as tending to diminish blood-flow in the coronary vessels. Thiopentone and ether and oxygen were ordinarily employed, with routine sedatives in the earlier stages. Local anaesthesia alone is not employed as tending to cause strain due to unallayed anxiety.

[This is an excellent and detailed article, showing how the qualities of judgment and resource guided by general principles and an alert and flexible mind are to be used rather than a rigid system and hide-bound opinion.]

W. C. Spackman

17. **Foetal Deaths from Antenatal Anticoagulant Therapy.**

By R. G. Gordon and T. Dean. *Brit. med. J.*, **2**, 719–721. Sept. 17, 1955. 4 refs.

A 39-year-old multipara developed deep femoral thrombosis after her twin pregnancy had advanced to the 38th week. Treatment included ethyl biscoumacetate 200 mg. immediately, followed by 100 mg. twice daily for 48 hours and then thrice daily for 5 days. Macroscopic haematuria then developed and the treatment was stopped. The prothrombin time had been measured each day by the one-stage method of Quick.

Seven days later, labour commenced spontaneously. After a first stage of 4 hours 50 minutes and a second stage of 1 hour the first boy weighing 7 pounds 4 ounces was delivered spontaneously. This was a vertex delivery but the child was stillborn. The second infant, weighing 6 pounds 1 ounce, had an easy breech birth but was asphyxiated and responded poorly. Haemorrhage occurred from this child's cord 2 hours after delivery and soon after that a "blood blister" appeared on its upper lip. Spontaneous ecchymosis appeared on the anterior chest wall. Hydrocephalus began to develop and ventricular puncture revealed the presence of dark blood-stained C.S.F. Death occurred at the age of 35 days.

Post-mortem examination of the first baby revealed haemorrhages on the right side of the brain, in the pericardium and stomach and also into the testicles. The falx cerebri and tentorium were intact. The second infant was also examined post-mortem and was found to have marked internal hydrocephalus and a large amount of organizing blood clot at the base of the brain.

The authors believe that both infants died of generalized haemorrhages due to anticoagulant therapy given to the mother. Surveying the literature they found only 2 other similar cases to be recorded, though there were other references to similar haemorrhages occurring in the young of experimental animals treated with anticoagulants.

Others have reported successful use of anticoagulants in pregnancy, maintaining that the danger to the mother is so great as to justify the treatment, and that the danger to the foetus is negligible provided that the prothrombin index is properly controlled. Some, however, warn against anticoagulants in late pregnancy.

The present writers believe that the risk to the mother from antenatal femoral thrombosis is small and this experience leads them to recommend that anticoagulants should be withheld unless pulmonary embolism occurs. They also recommend that control of therapy by both the one-stage and the two-stage methods should be

undertaken if anticoagulants must be used, for in certain people the one-stage method may give false readings on the high side.

R. W. Grayburn

18. **Studies of Fibrinogen and Other Hemostatic Factors in Women with Intrauterine Death and Delayed Delivery.**

By J. A. PRITCHARD and O. D. RATNOFF. *Surg. Gynec. Obstet.*, **101**, 467–477. Oct. 1955. 7 figs. 9 refs.

In the Western Reserve University Hospitals in Cleveland, Ohio, studies of the concentration of fibrinogen in plasma were made in a total of 31 patients who remained undelivered 3 or more weeks after apparent intra-uterine foetal death. Hypofibrinogenaemia was thought to exist when the plasma concentration was less than 150 mg. per 100 ml.

In 23 patients no evidence was found of a critical depletion of circulating fibrinogen. In 7 of these patients serial fibrinogen determinations were made for several weeks following intra-uterine death; in all 7 there was a progressive reduction in the concentration of circulating fibrinogen but the concentration at no time reached a level lower than that in the normal non-pregnant woman.

During the same period 8 cases of prolonged intra-uterine retention of a dead foetus were encountered in which the fibrinogen level was dangerously low. In 3 instances haemorrhagic manifestations prompted studies of the fibrinogen concentration. In the other 5 cases the hypofibrinogenaemia was discovered in a routine study of patients with intra-uterine retention of a dead foetus.

In none of the patients with hypofibrinogenaemia was there ever any evidence of spontaneous correction of the hypofibrinogenaemia prior to delivery, but a normal or even elevated fibrinogen level was invariably present within 48 hours after delivery. In none of 12 patients investigated was there a significant change in plasma fibrinogen concentration during the course of labour.

The hypothesis that fibrinogen is destroyed by intense fibrinolytic activity is not supported by the data obtained from the study of this series of patients. In no case was the plasma fibrinolytic activity greater than that seen in other conditions in which no fibrinogen depletion was present.

In the patients with hypofibrinogenaemia, a moderate degree of thrombocytopenia and hypoprothrombinaemia was found and this is compatible with the concept that hypofibrinogenaemia is due to intravascular coagulation.

Although a number of the cases of hypofibrinogenaemia with death of the foetus were in Rh negative women the process is not peculiar to such patients as 3 of the patients studied were Rh positive.

The authors recommend that from about the third week after apparent foetal death the plasma fibrinogen concentration should be determined at weekly intervals. This will allow a margin of safety since hypofibrinogenaemia has not been described earlier than the fifth week after foetal death. Should the concentration of fibrinogen fall below 150 mg. per 100 ml., the uterus should be emptied promptly. At least 4 g. of human fibrinogen and several units of compatible whole blood should be immediately available.

John P. Erskine

19. **Afibrinogenaemia in Obstetrics.** (Les hémorragies par afribrinogénémie acquise en obstétrique.)

By F. LEPAGE, L. LEMERRE and A. DUPAY. *Gynéc. Obstét.*, **54**, 180–201. 1955.

These cases can be divided into three classes:

(1) Serious cases with a very bad prognosis unless treated by intravenous fibrinogen.

(2) Less serious types, responding to massive blood transfusion, probably thanks to displacement of the glycogen stores in the liver into the general circulation.

(3) Latent forms in which the haematological syndrome exists but only makes itself known at the spontaneous onset or induction of labour.

Amongst the theories put forward to explain the sudden disappearance of fibrinogen that which stresses the important function of the thromboplastin in the amniotic fluid appears to be the most satisfactory.

Cases are associated with three clinical conditions:

(1) dead foetus with or without Rh sensitization, (2) amniotic emboli, (3) serious cases of premature separation of the placenta.

Treatment is primarily directed against the inability of the blood to coagulate by administering 4–12 grams of fibrinogen intravenously in dextrose; and the blood volume is restored by massive blood transfusions and plasma.

D. Maxwell

20. **Therapeutic Premature Termination of Pregnancy in Cases of Rh Sensitization.** (Interruption prématurée thérapeutique de la gestation en cas d'iso-immunisation anti Rh.)

By H. PIGEAUD and H. GABRIEL. *Gynéc. Obstét.*, **54**, 202–208. 1955.

Before 1952 termination several weeks prior to theoretical full time, either by induction or Caesarean section, was considered the essential treatment of sensitized babies with Rh negative mothers.

Since 1952 certain authorities have written strongly against this, holding that the premature delivery of these sensitized children results in an important number of cases of kernicterus. Professor Pigeaud and his obstetrical colleagues at Lyon are not in agreement with this, and they report an analysis of 67 cases of sensitized mothers collected in the last 6 years. Of these 61 were previously published in detail by one of them (H. Gabriel, *Thesis*, University of Lyon, 1954). Only 47 of them concern this paper as the other 20 are discounted owing to their being concerned with the ABO system of blood groups. They hold that in order to decide treatment the answers to 2 essential facts must be known: (1) what is the foetal mortality in premature birth in contrast to that at theoretical full time? (2) What is the risk of kernicterus when pregnancy is terminated prematurely?

As the Anglo-American writers say, following Diamond's and Mollison's condemnation in 1952 of

premature interruption of pregnancy for these cases, "dead children were being replaced by living idiots".

The writers have found in their 47 cases that prophylactic therapeutic premature termination reduces foetal mortality but does not increase in any way the incidence of kernicterus. Not a single case of "living idiot" has been traced in the follow up of their 47 cases by paediatricians with special psychiatric knowledge.

They sum up by saying: If sensitization is certain in any case delivery is advised 28–30 days before term. If sensitization is uncertain, but nevertheless probable, delivery is advised 15 days before term. Replacement transfusion, when indicated, should be carried out with the least possible delay.

D. Maxwell

21. **The Problem of the Iso-immunized Rh Negative Mother.**

By J. G. SHELTON. *Med. J. Aust.*, **2**, 113–116. July 23, 1955. 7 refs.

This paper, together with one on the paediatric aspect by Kate Campbell, and one by Vera Kreiger on the serological aspect, forms a report on work at The Royal Women's Hospital, Melbourne during 1952 and 1953. The series includes 146 immunized mothers studied in a special clinic and does not include all such mothers presenting at the hospital. An attempt was made to decrease the mortality rate among live-born infants and to lessen the incidence of kernicterus.

In an Rh positive baby with a positive Coombs test and a haemoglobin value below 14·8 g. per 100 ml. an exchange transfusion was given. In addition, if the haemoglobin value was above this level and jaundice appeared within 8 hours, an exchange transfusion was given.

Among the 146 pregnancies 103 infants (71 per cent) lived; 7 (5 per cent) were born alive but died within 1 day; 31 (20 per cent) were still-born. There were 6 abortions. Twenty-four of the surviving babies were Rh negative. Of the 68 babies who were affected clinically and in whom the Coombs test was positive 63 had exchange transfusions. In 16 instances the babies were unaffected in the presence of a positive Coombs test. Where the history (which was checked) revealed that the previous baby had suffered erythroblastosis 60 out of 91 survived. In this series where there was a history of a previous erythroblastotic baby there was a 1 in 4 chance of an Rh-negative baby in the subsequent pregnancy.

Titre values proved disappointing with regard to prognosis. However, it was found that in those cases where the titre value was high or rising the baby was almost certain to be affected clinically and to require exchange transfusion provided it was an Rh positive baby. Out of 7 babies that died despite exchange transfusion 5 were delivered at 38 weeks or less and of 3 babies with kernicterus still living, all were delivered after premature induction of labour. The correct way to manage the pregnancy of an immunized mother is not to induce labour.

S. Devenish Meares

22. **Diaphragmatic Hernia and Pregnancy.**

By A. W. DIDDLE and K. A. O'CONNOR. *Obstet. Gynec.*, **5**, 811–814. June 1955. 9 refs.

The authors report a case of strangulated diaphragmatic hernia during pregnancy in which the patient survived. An infectious illness complicated by vomiting precipitated a partial strangulation of a para-oesophageal hernia. As a result there was bleeding into the stomach, causing persistent nausea and vomiting. The authors have seen 18 cases of diaphragmatic hernia one of whom died in the second stage of labour from a perforation of the stomach and another died in the eighth month of pregnancy with a gangrenous herniated bowel.

In the light of this experience they treated the case described by gastric suction and intravenous therapy. Labour was induced and a forceps delivery performed. Post-partum, the patient was gradually given fluids to drink and then a light diet.

J. G. Dumoulin

23. **Intestinal Ileus in Pregnancy (Volvulus) in Association with Torsion of an Ovarian Cyst.** (Gemeinschaftliches Vorkommen von Ileus in graviditate (Volvulus) und Torsion einer ovariellen Zyste.)

By S. FERKÓ. *Gynaecologia, Basel*, **140**, 145–154. Sept. 1955. 2 figs. 20 refs.

The aetiology, diagnosis, course, treatment and prognosis of ileus in pregnancy are discussed, with a review of the literature.

A case is reported in which torsion of an ovarian cyst occurred during the 8th month of pregnancy, simultaneously with a volvulus of the sigmoid colon. The operation was performed through a left pararectal abdominal incision and this is strongly recommended for cases of this kind. The patient recovered from the operation and was delivered by Caesarean section with sterilization 6 weeks later.

The importance of early diagnosis and early operation in cases of ileus in pregnancy is emphasized. In the case described it was thought that torsion of the pedicle of the ovarian cyst had set up diarrhoea, thus precipitating volvulus of the colon.

Josephine Barnes

24. **Management of the Pregnant Diabetic.**

By J. H. PEEL. *Brit. med. J.*, **2**, 870–874. Oct. 8, 1955. 10 refs.

The author gives his personal experience of 298 pregnancies in diabetic women seen during the last 11 years. He discusses the pre-diabetic state and the importance of following up the patient who has delivered a large still-born baby without other explanation for the stillbirth.

When pregnancy occurs in the established diabetic, the author feels there may occasionally be grounds for termination, especially if hypertension or albuminuria is present. If pregnancy continues, he emphasizes the need of close co-operation between patient and physician. The lowered renal threshold, tendency to vomiting, and altered insulin requirements all make management difficult.

The main problems for the obstetrician arise during the

last trimester, when hydramnios, toxaemia and intra-uterine death are liable to occur. He found no relation between the severity of the disease, or age of onset, and the foetal loss. The foetal loss was higher when toxaemia co-existed. Fairly acute hydramnios often heralded intra-uterine death.

During a prolonged clinical trial of hormone therapy, a series of hormone assays was carried out, the results so far suggesting that if perinatal death is impending an abrupt and progressive drop in the excretion of pregnanediol occurs between the 30th–32nd week. This may be of prognostic significance.

Fifty-six patients were treated with stilboestrol and ethisterone throughout pregnancy. The daily dose of 50 mg. of stilboestrol was increased gradually to 200 mg. after the 32nd week, and the daily dose of ethisterone was increased similarly from 25 mg. to 250 mg. Thirty-five babies survived in this series. Compared with a control series, there was no alteration in oedema, albuminuria, toxaemia, hydramnios, or alteration in the birth weights. It is considered that substitution therapy corrects the hormone imbalance, but has no effect on the function of the placenta or foetal survival.

The author still recommends termination of pregnancy before the 37th week, and earlier in the presence of hydramnios, or toxaemia. Caesarean section is usually recommended, rather than surgical induction of labour.

The author does not feel that congenital abnormalities or hypoglycaemia are an important cause of neonatal death. In 85 per cent of neonatal deaths hyaline membrane was demonstrated—possibly due to intra-uterine anoxia.

Eileen Wilson

25. **The Use of Hormones During Pregnancy in Diabetes.**

By the Medical Research Council Conference on Diabetes and Pregnancy. *Lancet*, **2**, 833–836. Oct. 22, 1955. 2 figs. 8 tables. 8 refs.

It has been widely held in America that female sex-hormone therapy of the pregnant diabetic has resulted in a great saving of foetal life. In view of this claim the Medical Research Council appointed a Committee to assess the effect, if any, of treatment by oral administration of stilboestrol and ethisterone upon the foetal survival-rate in pregnancy among diabetics.

This article reports the results obtained from the clinical trial undertaken at nine centres. The patients selected conformed to certain clinical criteria and were placed at random into "hormone-treated" and "non-hormone-treated" groups. From a total of 147 diabetic pregnancies there were 53 living children out of 76 cases in the hormone-treated group, and 49 living children out of 72 cases in the non-hormone-treated group. Hence the foetal salvage rate is approximately 69 per cent in each group. Similarly, when the groups are divided up according to parity there is no important difference in the outcome between the hormone-treated and non-hormone-treated groups. The mean dates of delivery were substantially the same in the two groups. Premature birth was not, therefore, less common among the hormone-treated patients. Similarly the abortion rate in the two groups was approximately 8 per cent. The mean weights of all the children weighed in the hormone-treated group was 7·4 pounds and in the other group 7·1 pounds, which does not suggest that hormone therapy reduces the excessive weight of the foetus in the diabetic pregnancy. There were 4 congenital abnormalities (5·3 per cent) in the hormone-treated group and 7 (9·7 per cent) in the other; and the defect was associated with foetal loss, although not necessarily its cause, in 3 cases in each group. Hydramnios was equally common in the two groups. The proportion of patients in whom albuminuria was reported was almost equal in the two series; the same was true of the reporting of oedema. There were two maternal deaths, one from each group, during the trial. Both occurred following Caesarean section. From these findings the Committee conclude that oral stilboestrol and ethisterone in the doses prescribed in the trial do not reduce the foetal mortality in diabetic pregnancies and have little if any beneficial effect on maternal health.

H. H. Fouracre Barns

26. **Placental Transmission of Isonicotinic Acid Hydrazide.**

By Y. M. Bromberg, M. Salzberger and I. Bruderman. *Gynaecologia, Basel*, **140**, 141–144. Sept. 1955. 1 table. 10 refs. [In English.]

Isoniazid (isonicotinic acid hydrazide or INH) is easily absorbed when given orally. In lactating mothers it diffuses freely in the milk. Toxic effects on the central nervous system, liver and kidney have been reported and thus it was decided to determine the rate of diffusion into the umbilical cord, to see whether the drug could be found in toxic levels in the foetal circulation.

A single dose of 100 mg. of isoniazid was given by mouth to 19 women during labour. At the time of delivery, one quarter to 1¼ hours later, samples of maternal venous blood and of blood from the umbilical vein were taken for isoniazid determination.

It was found that isoniazid diffuses freely through the human placenta at term, while in 7 out of the 19 cases the concentration of isoniazid in the foetal circulation was even higher than that in maternal blood. Such levels are known to produce therapeutic and/or toxic effects in adults.

It is concluded that prolonged administration of isoniazid to the mother may be toxic for the foetus but further clinical observation of newborn infants delivered by mothers treated with isoniazid is necessary to confirm or disprove this assumption.

Josephine Barnes

27. **Poliomyelitis in Pregnancy.**

By P. Hom. *Obstet. Gynec.*, **6**, 121–137. Aug. 1955. 29 refs.

This paper presents 325 pregnancies among 16,268 cases of poliomyelitis in Los Angeles County during the years 1934–53 with a mortality rate of 5·2 per cent (17 deaths) in pregnancy.

The maternal mortality rate fell from 10·9 per cent before 1948 to an average of 3·7 per cent since then.

Since 1948 there has been marked improvement in the treatment of bulbar spinal poliomyelitis with performance of early tracheotomy and endotracheal suction of mucus, administration of oxygen and helium, the use of positive-pressure devices, antibiotic therapy, and a better understanding, management, and therapy of fluid, protein and electrolyte balances.

The cases were divided into 125 non-paralytic, 125 paralytic and 75 bulbar spinal. Mortality is dependent on the severity of the disease, and is no greater in the pregnant than the non-pregnant. Abortion may occur if the illness is critical or if there is high fever. The known foetal loss includes 2 neonatal deaths from poliomyelitis, although there was no case of intra-uterine transmission of the disease. The total foetal loss was 22 per cent.

Pregnancy is only terminated for obstetric indications, with exception of a few acute severe progressive bulbar spinal cases occurring 4 to 6 weeks from term. In these Caesarean section is indicated. Once a patient has become stabilized to respirator care, spontaneous onset of labour and vaginal delivery are anticipated. Positive-pressure devices are extremely useful in facilitating nursing care, and in the conduct of labour and delivery.

Poliomyelitis is more frequent but no more severe or fatal in the pregnant than in the non-pregnant.

J. G. Dumoulin

28. **Report on 235 Cases of Ectopic Pregnancy.**

By S. VISHNIAVSKY and A. WOLFSON. *Gynaecologia, Basel*, **140**, 90–98. Aug. 1955. 4 tables. 4 refs. [In English.]

This is a review of 235 cases of ectopic pregnancy, encountered during a 7-year period in which 1,157 major gynaecological operations were undertaken. In the same period there were 32,141 hospital deliveries, giving an incidence of 1 in 137 cases. It was found that the majority of the cases, 88·6 per cent, occurred in the age group 20 to 40. Menstruation was normal in 227 cases, only 8 per cent having irregular periods. Thirty-six per cent were nulliparae; 25 per cent considered themselves sterile before conceiving. A total of 135 women, or 58 per cent, had a history of abortion; 99 of these had had induced abortions. Out of 22 women suffering from primary sterility, 14 had already received treatment; 12 women complained of secondary sterility. There were 25 women with a history of previous abdominal operations, 17 with ectopic pregnancy, 2 operated on before for ectopic pregnancy on the same side; 2 had had Caesarean sections, 4 ovarian cysts, 1 appendicectomy and 1 laparotomy.

Symptoms in order of frequency were: blood-staining, brown or black discharge, 232; fainting, 66; vertigo, 25; collapse, 24; shoulder pain, 20; vomiting, 16; fever, 5; diarrhoea, 2.

Puncture of the pouch of Douglas helped to establish the diagnosis in 104 cases where blood was aspirated; in a further 11 cases nothing was found. The Aschheim-Zondek test was positive in 36 out of 38 cases. In 28 suspected cases curettage revealed decidua but no villi; the authors do not consider this to be diagnostic in the absence of other signs or laboratory findings.

There were 122 cases of right-sided ectopic pregnancy and 113 cases of left-sided ectopic pregnancy. In 68 cases the tube was ruptured. Other coincidental pathological conditions encountered included fibroids, ovarian cysts, endometriosis and 3 cases of tuberculous salpingitis. One of the cases of tuberculous salpingitis had been known and treated before conception. The other 2 were diagnosed by histological examination on removal of the tube. Both were treated with Streptomycin and P.A.S. and both conceived again outside the uterus.

Salpingectomy was carried out 159 times, and adnexotomy 74 times; removal of fibroids was carried out 15 times, hysterectomy twice and removal of ovarian cyst 14 times. Altogether 48 additional operations were carried out when dealing with extra-uterine pregnancy. The authors believe that this is entirely safe, provided the general condition of the patient is satisfactory.

Two women died, one of heart failure and one of pulmonary embolism, giving a mortality of 0·8 per cent, the smallest that could be found in the literature.

The only possible treatment is operation as soon as diagnosis is certain. Blood transfusion is invaluable and was given in 66 cases. Antibiotics help to reduce post-operative morbidity. Intra-arterial blood transfusions have been given in desperate cases.

Josephine Barnes

LABOUR

29. **Composition of Maternal Blood Before and After Labour.** (Confronto della massa totale del sangue e del plasma e dopo il parto.)

By R. TORSELLO. *Minerva ginec., Torino*, **7**, 615–618. Sept. 15, 1955. 2 figs. 5 tables. 10 refs.

The author of this paper has studied the changes in the maternal blood which occur during labour and in the following days, and the extent and speed at which normal values are restored by the natural resources of the body. He estimated the haematocrit value, the haemoglobin percentage, the total protein content, the plasma volume and the total blood volume just before delivery, and on the first, third and seventh days after labour in a small series of normal cases that were not receiving special treatment. He found that for these four selected days the average haematocrit values were 37·6, 36·07, 35, and 37·76; for haemoglobin 74·23, 72·15, 67·66, and 74·07 per cent; and for total protein 7·38, 7·13, 6·80, and 7·43 g. per ml. Under these three headings the lowest values are reached on the third day of the puerperium and full recovery has occurred by the seventh. On the other hand, the total volume of the plasma averaged 3,572 ml., 2,945 ml., 2,875 ml., and 2,770 ml., on the above four days, showing a progressively lower value for the total plasma volume up to the end of the seventh day; and the total blood volume on those days was 5,564 ml., 4,503 ml., 4,257 ml., and 4,289 ml., showing commencing recovery by the seventh day although the value was still well below that seen before labour.

It is interesting to compare his corresponding average figures for the non-pregnant woman, viz., haematocrit value 40, haemoglobin 79·6 per cent, total protein 7·1 g.

per 100 ml., plasma volume 2,527 ml., and total blood volume 4,043 ml.

W. C. Spackman

30. **The Diagnosis of Ruptured Membranes by Identification of Fat Droplets in the Amniotic Fluid Seen in Vaginal Smears.** (Diagnostic de la rupture des membranes par la recherche des graisses du liquide amniotique sur le frottis vaginal.)

By M. DUMONT. *Gynéc. Obstét.*, **54**, 227–231. 1955. 3 figs. 9 refs.

The writer considers that it is possible to diagnose rupture of the membranes in cases of doubt by microscopic evidence of fat droplets in the vaginal fluid, stained by "cerol noir R.A.L." (made by Kohlmann), used as a saturated solution with 90 ml. crystallized acetic acid and 10 ml. of 90 per cent alcohol. This solution stains the fat droplets black. He found false negative results in 23·75 per cent of cases and false positives in 9·8 per cent. He concludes that it must only be considered as a diagnostic aid. In cases of trial labour it is of some importance to decide whether the membranes are ruptured.

In patients with oligo-hydramnios the diagnosis may be very difficult. Occasionally an amnio-chorionic pocket may rupture without opening the true sac. Estimation of the pH of the vagina using dibromo-thymol is of considerable use as a diagnostic aid, especially if urine, blood or soap was suspected in the vagina. The author agrees with Ahumada that the presence of urinary crystals or lanugo hairs in a single vaginal smear is often misleading. This applies also to Bourgeois's technique of searching for foetal epithelial cells in the vagina or suspicious fluid. He prefers his own staining fluid to Sudan III.

A total of 80 cases was examined with 76·25 per cent correct results, and 51 cases where the membranes proved later to be intact with 90·2 per cent correct results.

D. Maxwell

31. **Twin Pregnancy and Delivery.**

By G. R. KURTZ, W. J. KEATING and J. B. LOFTUS. *Obstet. Gynec.*, **6**, 370–378. Oct. 1955. 11 refs.

This report encompasses 500 consecutive twin pregnancies between 1947 and 1953. There was no maternal death. Cases where the combined weight of the twins fell below 1,500 g. (3 pounds 4½ ounces) were eliminated as were those in which one twin was a foetus papyraceous.

The incidence of twin pregnancy was 1 in 98. The main cause of foetal loss was prematurity, 46 per cent of the group failing to carry beyond the thirty-seventh week. Fifty-six per cent of the twins weighed less than 2,500 g. (5 pounds 7½ ounces), and this group accounted for 93 of the 97 deaths. Of the prematures more first and fewer second twins survived than single prematures. Twins of given gestational age tended to weigh less than single infants of the same age. Some mature twins weighed less than 2,500 g.

In 329 pregnancies both babies were of the same sex, and in 171 they were of different sexes. At the onset of labour 383 (76·6 per cent) of the first twins were vertex presentations and 106 (21·2 per cent) were breech. The second twin group contained 266 (53·2 per cent) vertex presentations and 180 (36 per cent) breech. The prognosis for either twin was poorer when presenting by other than vertex. The loss of second twins was 100 per cent greater than that of first twins. The twins both presented as a vertex 197 times (39·4 per cent), both as a breech 35 times (7 per cent). There was a vertex and a breech presentation in 204 cases (40·8 per cent). There was no case of locked twins.

In only 7 cases (1·4 per cent) was labour longer than 36 hours. The authors find that oxytocics, even when mistakenly administered too soon, have no deleterious effect upon the second twin.

J. G. Dumoulin

32. **The Effect of Aneurin on the Activity of the Uterus in Labour.** (Über die Wirkung des Aneurins auf die Wehentätigkeit.)

By B. NOLD and R. HUBER. *Gynaecologia, Basel*, **140**, 102–110. Aug. 1955. 8 figs. 12 refs.

A tocographical study of the uterus in labour, using Lorand's tocograph has been carried out to study the effect of aneurin on the uterus in labour. No effect was noted when vitamin B_1 (aneurin hydrochloride) was injected intramuscularly in doses of 200 mg. It is concluded that aneurin is useless for stimulating uterine contractions or for relieving the pain of labour.

It is suggested that it might help women suffering from deficiency of vitamin B but will be of no clinical benefit to the normal woman.

Josephine Barnes

33. **Early Roentgen Diagnosis of Spastic Contraction Ring in the Uterus (Bandl's Ring) during Labour and Roentgenographic Demonstration of the Subcutaneous Fat Deposits of the Fetus ("The Fat Line") and of the Placenta.**

By N. LAUGE-HANSEN. *Amer. J. Roentgenol.*, **74**, 315–322. Aug. 1955. 5 figs. 14 refs.

Analysis of a series of 23 cases of dystocia due to Bandl's ring from the Maternal Hospital, Copenhagen, showed that in 20 a dead foetus was born after severe intra-uterine manipulations and that there were 3 cases of ruptured uterus with 2 maternal deaths. Factors found to contribute to these unfortunate results comprised early rupture of the membranes with escape of liquor amnii, the injection of oxytocics and irregular or abnormal presentation which interfered with regular uterine contraction. The main obstacle to satisfactory treatment lay in the difficulty of diagnosis which in general was made only by intra-uterine examination in the course of a painful, protracted and non-progressive labour. However, a study of some films from 3 cases of difficult labour due to contraction ring showed the possibility of discovering the condition radiologically, thus obviating the need of obstetric interference for establishing a diagnosis. In a subsequent series of 7 cases of dystocia the presence of a spastic ring suspected on clinical grounds was confirmed by roentgenogram before manipulation had taken place and was associated

with the birth of 6 living infants, the seventh, a breech, having died from cerebral asphyxia due to constriction of the foetal neck by the spastic ring.

The conclusion was drawn that the diagnosis of contraction ring can be made simply and reliably by radiological examination as it was possible to demonstrate its presence in all of 10 cases, later confirmed, which were subjected to roentgenology. The ring was most easily seen in the lateral view "a massive, well defined, homogeneous soft part shadow, the acute apex of which pointed to the foetal neck (and thorax), which strongly suggested the presence of a spastic contraction ring in the distal uterus in cephalic presentation (most frequent) or in the proximal part in breech presentation". It was also learned that a band resembling Bandl's ring may be seen during pregnancy but disappears in early labour being effaced by uterine contraction which shortens the birth canal and causes descent of the foetus. One other additional feature apparent from the study was the presence of the foetal subcutaneous "fat line" which appears as a clear line of demarcation between the uterine wall and main foetal structure. The delineation when visible may aid in the diagnosis of a contraction ring.

John H. Mulvany

34. **Abnormalities of the Third Stage of Labour.**
By H. N. RAY. *J. Obstet. Gynaec. India*, **6**, 7–14. Sept. 1955. 12 refs.

This paper was read at the Eighth All-India Obstetric and Gynaecological Congress. It divides abnormalities of the third stage into five categories. First, there is post-partum haemorrhage, defined as blood loss of over one pint, or loss sufficient to cause symptoms. The treatment prescribed, if the placenta is retained, is manual compression by Credé's method, repeating the attempt under anaesthesia if it fails the first time. If this does not succeed, manual removal is carried out. Intravenous fluids, oxytocic drugs, and bi-manual uterine compression may be employed. The decision whether oxytocics should be given before placental separation, is left to individual obstetricians. The uterus and vagina are plugged as a last resort. A table is given, showing the methods of treatment of 109 cases of post-partum haemorrhage occurring in a series of 3,539 deliveries.

Secondly, there were 23 cases of retained placenta in this series. The view is expressed that the most important cause of these atonic non-detachments is a developmental deformity of the uterus, with cornual implantation of part of the placenta. Treatment was by injection of saline into the cord, manual removal, and hysterectomy. Injection of saline into the cord was unsuccessful in 50 per cent of cases, when the placenta had to be removed manually. Hysterectomy was resorted to in one case, for placenta accreta. The longest period of retention was 10 hours, and there was one death.

Thirdly, one case of acute inversion of the uterus is mentioned, and the possible aetiology of the condition briefly discussed. The fourth abnormality was obstetric shock, a condition which was not encountered in the series quoted, except as a result of post-partum haemorrhage, retention of the placenta, and inversion of the uterus.

The fifth category included 7 cases of traumatic post-partum haemorrhage due to tears in the lower genital tract which were sutured.

John McKiddie

35. **A New Manoeuvre for Expelling the Placenta.** (Nueva maniobra para expulsar la placenta.)
By F. ORENGO. *Obstet. Ginec. lat.-amer.*, **13**, 69–73. Mar.-Apr. 1955. 6 refs.

Whilst studying the case records of 491 patients on whom manual removal of the placenta had been performed, and comparing them with a series of 420 cases who had received an injection of an oxytocin during the birth of the anterior foetal shoulder, the author devised the manœuvre for expelling the placenta, which he now describes.

A short historical account of the management of the third stage of labour is given, leading up to the present day method of waiting for separation of the placenta and then performing manual expression. This last phase appeared unsatisfactory to the author, because in his opinion it frequently brought the cervix near to the introitus, thereby increasing the risk of uterine infection, as well as possibly interfering with the venous drainage of the uterus, so that rupture of the vessels might occur and haemorrhage ensue.

The author feels that a more practical approach to the problem is to hold the umbilical cord with the right hand, whilst employing the left hand to grasp the right side of the uterus and push it upwards towards the patient's left side. In a series of 70 cases, in which the placenta was delivered by this manœuvre, there were only 3 failures, which were due to breaking of the umbilical cord; otherwise the author claims that his technique proved very satisfactory, and his friends who adopted the procedure reported favourably.

In conclusion, the author suggests that there are three reasons for the efficacy of his manœuvre: (1) direct traction on the placenta through the cord, (2) straightening of the uterus, (3) probably more easy separation of the membranes which so often curb expulsion of the placenta.

John F. Foulkes

36. **An Analysis of 315 Cases of Adherent and Retained Placenta at Women and Children's Hospital, Egmore, Madras.**
By R. K. TAMPAN. *J. Obstet. Gynaec. India*, **6**, 53–59, Sept. 1955.

An analysis is made of 315 cases of retained placenta, occurring in 45,624 deliveries over a 5-year period. The total incidence was 0·69 per cent, the incidence being maximum in primiparae, and showing a diminution with increasing parity. The majority of the women delivered in the hospital were in the 20–30 age group, and the maximum number of cases occurred between these ages. The incidence of the complication could not be related in any way to the duration of labour, and

post-partum haemorrhage was present in 68 per cent of cases.

If the placenta is retained for half an hour, treatment is begun by attempting to expel it by Credé's method, once without anaesthesia, and once under an anaesthetic. A manual removal is then carried out, and shock is treated in the usual way. Seventy per cent of retained placentae had to be removed manually. Of the cases which had a morbid puerperium, all had manual removals, 1 case dying of peritonitis 3 days after delivery. The puerperium was febrile in 120 cases. There were 23 maternal deaths in the whole series, 10 of which were attributed to shock and haemorrhage resulting from retention of the placenta.

John McKiddie

37. **Post-partum Blood Loss: An Analysis of 12,046 Cases.**

By P. M. NAIDU, K. K. DEVI and J. DORAISWAMI. *J. Obstet. Gynaec. India*, **6**, 21–34. Sept. 1955. 20 refs.

An enquiry into the post-partum blood loss at Osmania Hospital, Hyderabad, was undertaken. The theories of the physiology of placental separation are mentioned, together with the methods of placental delivery employed in the hospital. The method of collecting the blood was by placing a kidney dish against the perineum.

In the total series, 88·5 per cent of cases lost up to 4 ounces, and loss was limited to 6 ounces in 95 per cent of cases. Seventy-five per cent of the deliveries were conducted without the use of oxytocics, and about 94 per cent of these cases lost up to 4 ounces of blood. In the remainder, in whom post-partum haemorrhage was to be anticipated, ergometrine was given prophylactically both after delivery of the child and after delivery of the placenta. Of these, 67 per cent lost up to 4 ounces. All patients were put in Sim's position after delivery, as this was thought to increase uterine tone, and stop bleeding.

It is stated that with physiological management of the third stage, and by using oxytocics in selected cases, blood loss can be limited to under 6 ounces in 95 per cent of cases. The total incidence of post-partum haemorrhage was said to be 0·08 per cent, and was compared with representative figures of 3 per cent from Great Britain and of 2–3 per cent from the United States of America. The period covered was 3½ years. Thirteen patients lost over half a pint of blood in the whole series. Seventy-two blood transfusions were, however, given within the last 3 years, when a blood bank became available. There were 5 maternal deaths attributed to post-partum bleeding.

It is concluded that any blood loss over 4 ounces is abnormal, and that further attempts to reduce blood loss in the hospital are to be directed at antenatal correction of nutritional deficiencies, and slower delivery of the foetus in the second stage of labour.

John McKiddie

38. **Hypothermia in the Treatment of a Case of Post-partum Haemorrhage.**

By D. B. MURRAY and D. F. BRUCE. *Lancet*, **2**, 699–701. Oct. 1, 1955. 1 table. 17 refs.

The authors report the case history of a woman of 39 years, 5-gravida, who developed severe post-partum haemorrhage after the delivery of the placenta. Vaginal examination under anaesthesia revealed bilateral cervical lacerations with arterial bleeding, and these were sutured. In spite of this, bleeding recommenced after the operation and in spite of conventional methods of treatment the patient's condition deteriorated. The uterus and vagina were packed and this produced even more shock. Hysterectomy offered the only hope of recovery and this was carried out under hypothermia anaesthesia. At operation the uterus was found to be well retracted on to the intra-uterine pack and there was no evidence of uterine rupture. Subtotal hysterectomy was carried out and the bleeding ceased (one must conclude that the lacerations were incompletely sutured in the first place). The patient recovered after a somewhat hazardous convalescence and when seen 9 months later was apparently in good health. The authors point out that the possibility of invisible damage due to anoxia taking place in the kidneys, pituitary gland and suprarenal gland was a constant source of anxiety. They conclude that there can be little doubt that reduction in the oxygen requirements of the tissues brought about by hypothermia in the critical phases must have contributed substantially to the protection of these organs.

H. H. Fouracre Barns

39. **Severe Post-partum Haemorrhage Associated with Fibrinogen Deficiency.**

By H. A. KELSEY and J. M. B. MUIRHEAD. *Lancet*, **2**, 705–706. Oct. 1, 1955. 10 refs

The authors describe a case of severe post-partum haemorrhage following the delivery of the placenta. The uterus was packed on 2 occasions whilst the patient was being transfused. It was found that the patient's blood did not clot after 15 minutes. Fibrinogen was given intravenously with immediate improvement in the clotting power of the blood and the shock responded to intra-arterial blood transfusion. The case exemplifies the danger of fibrinogen deficiency in an apparently uncomplicated case of post-partum haemorrhage. The authors conclude that in any case of post-partum haemorrhage where the haemorrhage persists despite an intact and well-retracted uterus, the clotting power of the blood should be tested and, if impaired, fibrinogen administered.

H. H. Fouracre Barns

LACTATION

40. **The Use of a Micronized Mixed Estrogen in the Postpartum Suppression of Lactation.**

By M. L. STONE, T. H. MCGAVAGE and A. DONNENFIELD. *West. J. Surg. Obstet. Gynec.*, **63**, 657–658. Oct. 1955. 7 refs.

The authors (from the New York Medical College) used a finely divided mixed oestrogen to suppress the lactation of 71 patients, 50,000 units being given orally twice daily for 5 days. Sixty-eight patients remained free from engorgement and pain, and no patient required an analgesic; leakage of milk was slight even when fluid

intake was not restricted. No excessive withdrawal bleeding occurred, and the lochia remained normal. The main advantage of the product is the absence of late secondary engorgement. It was well tolerated by the gastrointestinal tract, and there were no allergic reactions. Other patients received stilboestrol, a placebo and another conjugated oestrogen. Neither the nurse nor the patient knew which product was being used. All these (including the placebo) were generally effective, but the micronized oestrogen gave the best overall result.

D. C. A. Bevis

INFANT

41. **Foetal Mortality in Essential Hypertension.**

By R. LANDESMAN, E. HOLZE and L. SCHERR. *Obstet. Gynec.*, **6**, 354–365, Oct. 1955. 26 refs.

Since 1932 there has been a progressive reduction in the prevalence of toxaemia of pregnancy at the New York Lying-In Hospital. In 1953 the frequency was 5·3 per cent. One quarter of these cases had essential hypertension; that is a blood pressure of 140/90 and over antedating pregnancy, or discovered during pregnancy before the twenty-fourth week, or persisting after 6 months post-partum. Whilst only 25 per cent of the cases of toxaemia were associated with vascular disease, the authors believe that about 50 per cent will eventually show essential hypertension.

In order to evaluate foetal survival in essential hypertension, the group was divided into mild and severe varieties, and each was further subdivided according to whether there was a superimposed toxaemia (albuminuria, oedema and a rise in diastolic blood pressure). There were 671 deliveries in the series covering 11 years.

The total infant mortality was 2·3 per cent. In the low-grade hypertensive group with superimposed toxaemia the infant death rate was 16·4 per cent (28 per cent of the 569 low-grade hypertensives fell into this group). Of the 102 patients with severe hypertension the foetal loss without superimposed toxaemia was 23·3 per cent and with superimposed toxaemia 41·3 per cent (superimposed toxaemia occurred in 28 per cent).

Prematurity was a frequent complication of hypertensive disease, and the authors believe that the basic severity of the vascular disease was a more important cause of this than the presence of superimposed toxaemia. The most important single factor in foetal survival was the time of onset of the superimposed toxaemia.

J. G. Dumoulin

42. **Perinatal Mortality.**

By E. M. GOLD. *J. Amer. med. Ass.*, **159**, 244–247. Sept. 24, 1955. 12 refs.

Perinatal mortality is defined in this paper as the combined loss from infant deaths under 7 days and the late foetal deaths over 28 weeks gestation. Statistics obtained from New York City for the years 1946–1953 show a decline in the perinatal mortality rate of 19·5 per cent. Early infant deaths are due to prematurity (the largest group), birth injury (the second major cause), malformations, erythroblastosis and anoxia. Late foetal deaths tend to fall into three groups: (1) Maternal causes such as toxaemia and general disease. (2) Causes in the foetus, placenta and cord. (3) Ill-defined or unknown causes, which accounted for 41·6 per cent of the late foetal deaths.

The author makes four suggestions to improve the perinatal mortality rate. (1) Investigation of family histories and environmental pathology in the preconceptional stage, with increased research into the role of endometrial insufficiency and uterine anomalies. (2) High quality of prenatal care, especially in the lower economic groups, women under 20, and non-white patients. (3) Skilled obstetric and anaesthetic care in all deliveries, especially in premature deliveries, and an increase in the number and quality of autopsies. (4) The formation of perinatal mortality committees on the lines of those at present used in the study of maternal mortality.

D. W. James

43. **Foetal Distress and Intra-Partum Foetal Death.**

By T. B. FITZGERALD and C. N. MCFARLANE. *Brit. med. J.*, **2**, 358–361. Aug. 6, 1955. 4 figs. 10 refs.

This is a study of 206 cases of foetal distress extracted from 3,168 deliveries (6·5 per cent) with a special investigation of predisposing factors in 128 of them.

Criteria of distress were:

(*a*) Foetal heart rates outside the limits of 110–160 per minute, or a rise above 150 or below 120 where the previous rate was significantly different.

(*b*) Arrhythmias, either irregularities of rhythm or wide swings in rate.

(*c*) The passage of meconium in vertex presentations.

As a routine, the foetal heart rate was charted hourly in the first stage and quarter-hourly in the second stage. More frequent auscultation was practised if the rate tended to vary, to be outside the 120–160 per minute range or if meconium were passed. Predisposing causes of distress were studied. There was no significant difference in the incidence where the mother was over 30 years of age compared with the younger group, but primigravidae showed a rate of 8·9 per cent compared with 4·6 per cent for multigravidae. Ante-partum haemorrhage with a live child at the onset of labour resulted in 13·1 per cent foetal distress compared with 6·1 per cent where there was no bleeding and comparable rates in toxaemia and non-toxaemic cases were 8·4 and 6·7 per cent, respectively.

Defining mature, as within 2 weeks of the expected dates, the rates for premature and postmature groups were 8·4 and 13·4 per cent compared with an overall incidence of 6·5 per cent.

The baby was classified as affected if it was stillborn or in fair or poor condition at birth.

A rise followed by a fall in the foetal heart rate had a 44 per cent incidence of affected infants, while the reverse sequence resulted in 60 per cent affected.

There were 45 cases of foetal death in labour and these comprised 37 per cent of all stillbirths in the period. Where signs of distress had been properly looked for, only 3 out of 26 suffered death without warning. Amongst

causes for stillbirth were 10 congenital anomalies and the cause of death was not known in 9 cases. Cord complications appeared to be the cause of distress on 58 occasions and 11 of the babies were stillborn.

The importance of speedy intervention is emphasized and supported by a stillbirth incidence of 13 per cent delivered operatively compared with 25 per cent receiving no treatment except possible episiotomy, in spite of the fact that distress appeared less serious in the latter group. Maternal oxygen inhalation may well be beneficial to the foetus but can be dangerous if it causes sufficient improvement for a decision to operate to be postponed.

A child crying well at birth may well have been in danger, for the initial effect of anoxia may be stimulant.

Doreen Daley

44. **Vascular Anomaly of the Umbilical Cord.**

By K. Benirschke and W. H. Brown. *Obstet. Gynec.*, **6**, 399–404. Oct. 1955. 19 refs.

The records of the placental examinations at 3 centres in Boston were reviewed by the authors with regard to vascular anomalies of the umbilical cord. In some cases anomalies of the cord may not have been looked for, so that it is difficult to judge their incidence.

In the 20-year period covered there were 55 cases in which the umbilical cord contained only 1 artery. The baby appeared to be normal in only 13 cases. There were 5 sets of twins with one of the twins having a normal and the other an abnormal vascular supply. In the 42 conceptuses that did not survive, 27 (64 per cent) had malformations, usually multiple. The placentae were frequently abnormal.

There was a 30 per cent incidence of toxaemia in the mothers of these cases and a high incidence of hydramnios.

J. G. Dumoulin

45. **Intramuscular Iron in Infancy.**

By W. Gaisford and R. F. Jennison. *Brit. med. J.*, **2**, 700–704. Sept. 17, 1955. 7 figs. 15 refs.

The advantages of intramuscular injection of iron over intravenous and oral therapy in the treatment of anaemia are discussed. This report describes the use of "imferon" in the treatment of anaemic infants. In all 100 infants and children were treated with this preparation but only the initial groups are presented. The first group consisted of 21 infants ranging from age 2–27 months and suffering from nutritional anaemia. Encouraged by the results, the authors then treated a second group of 14 infants with anaemia of prematurity. Their ages varied between 2–15 months.

This led to the prophylactic use of imferon in premature babies and the third group concerned 20 premature infants whose weights varied between 3 pounds 2 ounces and 4 pounds 13 ounces. Alternate admissions received injections during the third week after birth and the others were observed as controls. Babies weighing less than 4 pounds were given 250 mg. and those weighing between 4–5 pounds were given 150 mg. of imferon. Although the usual fall in haemoglobin during the first few weeks of life was not prevented, a significant difference in favour of the treated group appeared by the 16th week and was maintained. The average haemoglobin level at 24 weeks in the treated group was 82·2 per cent compared with 65·6 per cent in the untreated group.

In a final group of 10 cases imferon was administered in connexion with surgical conditions, sometimes instead of blood transfusion. The authors found that imferon produced a rapid clinical and haematological response which was maintained. The average rate of response was between 1·4 and 1·5 per cent haemoglobin a day but it is recorded that infections prevent utilization of parenteral iron and that reactions are more likely in the presence of infection.

Only the amount calculated to make good the iron deficiency should be given. The dose was calculated from the formula:

Fe required in mg. $+1 \cdot 31 \times (17\text{-Hb in g.}) \times$ wt. in pounds.

The 1·31 is a constant based on the iron content of haemoglobin (0·34 per cent) which gives 20 mg. of Fe per pound at a haemoglobin level of 14·8 g. per cent. $\frac{20}{14 \cdot 8} = 1 \cdot 31$ and is the number of mg. of Fe required to raise the haemoglobin 1 g. per 100 ml. for each pound of body weight. The figure 17 was chosen arbitrarily to allow for depleted iron stores (14·8+2·2). This figure was later increased to 19 with better results.

The injections were given deeply into the outer quadrant of the infant's buttock, daily, on alternate days, or weekly, according to convenience and the amount usually given at any one time was 50 mg. (1 ml.).

Parenteral iron is indicated in cases of intestinal disorder, in cases where rapid haemoglobin regeneration is required and for infants who would otherwise have to be admitted to hospital because of poor home conditions.

It has been suggested that blood transfusion is the only efficient method of preventing anaemia of prematurity, but the authors conclude that imferon has all the advantages of blood transfusion (or intravenous iron therapy) without the disadvantages.

R. W. Grayburn

46. **Maternal Factors that Influence the Severity of Erythroblastosis Foetalis.**

By H. L. Toate. *Obstet. Gynec.*, **5**, 819–825. June, 1955. 4 refs.

Erythroblastosis foetalis almost never occurs in the first pregnancy if there has been no incompatible transfusion. Rh negative women who have Rh positive husbands have a chance of about 1 in 46 of having an affected baby in their second pregnancy, gradually increasing to a 1 in 12 chance in the fifth pregnancy.

The author studied 300 pregnant women sensitized to Rh antigens. He found that abortions, erythroblastotic infants and transfusion of Rh positive blood were strong immunizing agents, abortions being more potent in this respect than normal pregnancies. Replacement transfusion reduced the mortality in live affected babies from about 35 per cent to about 5 per cent. The rate of occurrence of stillborn infants with hydrops was 3·6 per cent when there was a history of normal pregnancies only.

When there was a history of a previous erythroblastotic infant the stillbirth rate increased to 26 per cent. In spite of this, 45 mothers who had previously had affected infants subsequently gave birth to Rh positive infants that were less severely affected.

In studying the titre of the antibody the author found that a negative or low titre in early pregnancy that progressed to a low, moderate or high level usually indicated erythroblastosis of mild, moderate or severe degree respectively. It was a bad sign if the high titre dropped at or near term. If the titre remained constant throughout pregnancy or gradually diminished the mother usually gave birth to a normal Rh negative foetus.

J. G. Dumoulin

47. **Feeding Difficulties in Infancy: Their Cause and Prevention.**

By U. James and B. L. Coles. *Brit. med. J.*, **2**, 656–658. Sept. 10, 1955. 10 refs.

The 173 admissions to the Violet Melchett Mothercraft Home during the year from October, 1953 are analyzed —the purpose being to determine the factors which led to the feeding problems for which the cases were admitted and to suggest how some of them might be avoided.

Sixty-two of the cases were breast-fed babies. The factors which led to their admission were: underfeeding (20 cases), prematurity (18), normal cases for tuition (12), difficulties with breasts (8), overfeeding (4).

Eighty-three of the infants were artificially fed. The factors in this group were: unsatisfactory mothers (18), mothers for instruction (17), refusal to feed (10), refusal to take solids (9), social reasons (9), previous illness of infants (9), frequent changes of food (5), vomiting (3), screaming (3).

The final group of 28 infants were mixed feeders. In these cases intestinal disorders (11), poor home conditions (6), screaming (5), refusal to feed (5), and refusal to take all food (1), were the reasons for admission.

The majority of breast-feeding difficulties were found with the first child. Other feeding problems were more prominent in larger families. Maternal age was not found to be a precipitating factor; only 10 of the mothers were under 20 or over 40 years of age.

Mothers from good homes make greater efforts to breast-feed and in consequence more cases requiring advice are to be found in this group. Similarly, bad housing was almost twice as often met with in the artificially fed infants as in the breast-fed.

Twelve infants had been delivered at home as against 160 in hospital. This is in keeping with the high incidence of primiparae in the series and reflects, in part, the trend towards hospital confinements. The authors found that opportunity for contact between mother and child during the neonatal period in hospital is only moderate or bad in a large proportion of cases and they cannot exclude this as a possible cause of feeding difficulty.

Instruction in mothercraft and the nutritional needs of an infant are advised. Antenatal care of breasts, avoiding frequent changes from one type of infant food to another, and early introduction of mixed feeding are recommendations which may lead to prevention of most feeding problems.

R. W. Grayburn

MATERNAL MORTALITY

48. **The Causes and Prevention of Maternal Mortality.**

By E. W. L. Thompson. *J. Irish med. Ass.*, **37**, 277–280. Sept. 1955.

The maternal mortality in Ireland is now just over 1 per 1,000. In 1954 there were 61,899 births and 65 mothers died. The author considered the subject under three headings:

(1) Puerperal sepsis has virtually been eliminated as a cause of death, although severe illness from infection still occasionally occurs.

(2) In Ireland toxaemia is still a major cause of maternal death. Although better antenatal care has reduced the number of deaths, disasters from this cause still occur in women who appear to have had good antenatal supervision. The author considers that there are still too few antenatal beds in Ireland for the prophylactic management of mild cases. Difficulty also arises because it is often an economic disaster for the mother of a young family to be confined to hospital for several weeks. In the management of eclampsia the author stresses the importance of preventing multiple fits. When there is no rapid improvement or repeated fits occur Caesarean section gives the mother the best chance. For the fulminating case of pre-eclampsia at or before the 32nd week the pregnancy ought to be terminated by Caesarean section if there is no improvement within 36 hours of treatment in hospital.

(3) Whereas maternal deaths from placenta praevia should not occur in maternity hospitals, accidental haemorrhage remains a great danger even in the best surroundings. Post-partum haemorrhage is considered to be preventable in most instances.

The author draws attention to the need for two more major obstetrical units (in Cork and in Galway) and for a number of new minor units. There is also a need to raise the status of obstetrics in the Republic; it should no longer be considered a side line of medicine. Without any increase in knowledge, but merely by putting obstetrics on a new footing it should be possible to reduce the number of maternal deaths to less than 30 per year.

J. K. Russell

49. **Review of Maternal Mortality due to Third Stage at the Nowrosjee Wadia Maternity Hospital.**

By K. M. Masani. *J. Obstet. Gynaec. India*, **6**, 39–46. Sept. 1955.

An analysis is made of the factors responsible for maternal death in the third stage of labour in the hospital concerned. The report covers the period 1945–1953. It is stated that the maternal mortality figures in well equipped hospitals in India are comparable to those in Europe and America, but that the mortality in the country as a whole is high, due to the practice of obstetrics by untrained persons which still persists, the

absence of obstetric facilities in rural areas, and the prevalence of nutritional deficiencies.

Sixty-two thousand and fifty-three cases were dealt with in the hospital, with 34 deaths in the third stage, of which 24 occurred in the 4,000 emergency admissions. Although the risk to life was 48 times greater in emergency cases than in booked patients, this disparity still did not reflect the picture in rural districts, where poor communications prohibited the transfer of patients to hospital. In many places in India there are no facilities for blood transfusions, and in such places plugging of the uterus for post-partum haemorrhage is advocated. One case of retained placenta was treated prior to admission by the attendant standing on the abdomen. Five deaths were due to genital tract lacerations; 2 of these patients had spontaneous deliveries, and 3 were delivered instrumentally. It was thought that some of the deaths attributed to obstetric shock were due to lacerations extending into the broad ligaments. One-third of the deaths were associated with nutritional deficiency anaemia.

Under such circumstances, a plea is made for the establishment in India of some sort of liaison between maternity hospitals and those practising midwifery in the surrounding areas.

John McKiddie

OBSTETRIC OPERATIONS

50. **The Indications for Caesarean Section.**

By A. M. CLAYE. *N.Z. med. J.*, **54**, 284–296. June 1955. 3 tables. 20 refs.

In this, the opening paper at the first New Zealand Congress in Obstetrics and Gynaecology, the author reviews the indications for Caesarean section at the Leeds Maternity Hospital. He contrasts the indications in the years 1923–1928 with the indications in the years 1949–1952. In the first group there were 177 cases of Caesarean section performed for contracted pelvis in a total of 183 Caesarean sections. In the second series there were 91 Caesarean sections for contracted pelvis and disproportion in a total of 563 Caesarean sections. He observes that in many maternity hospital reports the term "contracted pelvis" is not used now, disproportion only being recorded. He makes a plea for calling cases of contracted pelvis by their own name, particularly since it is possible now to measure the size of the pelvis so accurately by X-ray pelvimetry. He makes a plea for the use of clinical judgment in interpreting X-ray pelvimetry films.

Elderly primiparity is the next indication for Caesarean section considered. He considers that this indication alone is not sufficient to justify Caesarean section. A trial of labour should be conducted, and then if there is unsatisfactory progress section should be carried out. In breech presentation with an elderly primigravida there is also a case for vaginal delivery. He quotes the figures from Liverpool reported by Cox (*J. Obstet. Gynaec. Brit. Emp.*, 1950, **57**, 197) giving the results of breech delivery. He concludes that these results are good enough to allow vaginal delivery when the breech presents in an elderly primigravida, provided that the obstetrician is skilful and that the progress of labour is satisfactory.

Other indications discussed are foetal distress, placenta praevia and transverse lie, and in each case the author recommends a conservative attitude.

In discussing pre-eclampsia and abnormal uterine action, the writer makes a more determined plea for vaginal delivery. Many cases of pre-eclampsia can have labour induced and he is not convinced that the condition of the cervix matters very much when attempting induction. Cervical incisions in suitable cases also are spoken of favourably.

The writer concludes that there is a danger with the increasing vogue of section that men will select it as the appropriate treatment because they are not experienced enough in vaginal methods of delivery and laparotomy appears to be the easy way out. The object of obstetricians is to obtain the lowest possible maternal and foetal mortality and morbidity.

Discussing this paper, L. C. L. Averill agrees in principle with Claye's remarks. He then details the use of vaginal delivery following previous Caesarean section. He records 1 case of ruptured uterus in his hospital, the patient having had 5 previous sections. This was an emergency case admitted in labour with a ruptured uterus and bladder. Averill believes that vaginal delivery in the great majority of cases where the lower segment operation has been performed is much safer than has previously been believed.

L. Woodrow Cox

51. **Multiple Caesarean Sections.**

By J. X. BREMNER and J. R. DILLON. *Obstet. Gynec.*, **6**, 85–92, July 1955. 21 refs.

This report presents 105 cases who have had 3 or more Caesarean sections without mortality. There was 1 case with 7 sections, 2 with 6, 9 with 5, 29 with 4, and 64 cases with 3 sections. The series includes 2 instances of incomplete rupture which were repaired. Low cervical sections were done in the majority of cases.

The authors consider that enough evidence is presented to show that sterilization is not a required procedure from a strictly medical standpoint.

J. G. Dumoulin

52. **Rupture of the Lower-Segment Caesarean-section Scar.**

By J. P. O'DWYER. *Lancet*, **2**, 324–325. Aug. 13, 1955. 7 refs.

The author describes a case of sudden rupture of a lower-segment Caesarean section scar just prior to making the abdominal incision for a second lower-segment section. This was undertaken because of slight disproportion and a history of febrile puerperium following the previous section. The old transverse uterine scar was ruptured throughout its length and in addition there was a vertical laceration through the anterior uterine wall beginning on the right side of the old scar and continuing up to the fundus. A sub-total hysterectomy was performed and sections around the ruptured area showed crystals like talc with associated

granulomatous changes. The author suggests that the talc deposits were a factor responsible for its disruption so early in labour.

H. H. Fouracre Barns

53. **Incision of the Cervix as an Operation for Shortening and Easing the Course of Labour.** (Muttermundsinzision als selbständige, geburtsbeschleunigende und geburtserleichternde Operation.)

By E. ROSENZWEIG. *Gynaecologia, Basel,* **140,** 155–162. Sept. 1955. 2 figs. 17 refs.

The operation of incision of the cervix during labour has been performed on about 1,000 cases, out of approximately 65,000 births in the University Women's Clinic at Zagreb. The operation is used to shorten the course of labour, not as an operative procedure to accompany delivery. A single incision is made anteriorly, and this always ends about 1½ cm. from the anterior vaginal fornix. The incision is made between two pairs of straight artery clamps; after delivery of the foetus and placenta three or four interrupted catgut sutures are sufficient to repair the incision. No serious complications have been encountered in many years of experience of the method.

Josephine Barnes

GYNAECOLOGY

54. **The Present Status of Vulvar Luminescence.**

By R. C. BENSON and M. VOGEL. *West. J. Surg. Obstet. Gynec.,* **63,** 660–662. Oct. 1955. 10 refs.

Since 1947 several papers have appeared in American journals describing various colours seen in the pudendal region on irradiation with ultra-violet light in different clinical conditions. Colours such as purple, green, yellow and red were thought to be related to ovarian hormonal variations.

The authors have compared the colours seen on irradiation with filtered light of 3,650 Å.U. with special fluorescent colour charts. Under carefully controlled conditions they could only identify blue-green and red fluorescence during pregnancy and the puerperium. The deep purple colour previously reported is a mixture of reflected red and blue radiation from the light source combined with the brown pigmentation of the perineal region. The blue-green colour is the normal luminescence of skin, but the red colour seems to be due to a porphyrin excreted by the apocrine gland system.

They conclude that the relationship of vulval fluorescence to various syndromes is so uncertain that clinical application is scarcely feasible at present.

D. C. A. Bevis

55. **Hematocolpos with Imperforate Hymen.**

By R. E. WARNER and R. M. MANN. *Obstet. Gynec.,* **6,** 405–409. Oct. 1955. 10 refs.

Five cases of haematocolpos with imperforate hymen are reported from the Elizabeth Steel Magee Hospital, Pittsburgh. Presenting symptoms include primary menorrhoea, cyclical abdominal pain, retention of urine and a lower abdominal mass.

The history of amenorrhoea and the finding of a bulging, bluish hymen is pathognomonic. Hymenectomy is the usual treatment, although laparotomy is sometimes indicated. It is wise to give antibiotic therapy.

J. G. Dumoulin

56. **Treatment of Leukorrhea with Douches and "Broad Spectrum" Therapy.**

By E. F. PENA. *West. J. Surg. Obstet. Gynec.,* **63,** 654–656. Oct. 1955. 14 refs.

The author briefly reviews the literature on leucorrhoea and points out that the infection is usually due to trichomonads or *Candida albicans* but that staphylococci, streptococci, and micrococci may also be responsible. Treatment must include a "broad spectrum" agent lethal to a wide variety of fungi and bacteria. The agent must be penetrative to get into all folds and crevices of the mucosa, must ensure a high glycogen content in the vaginal mucosa, must induce the growth of Döderlein's bacillus, must ensure a normal pH and must expedite the removal of the mucous debris from the vagina. To meet these needs, he recommends the use of two agents:

"Baculin" powder:	
Diiodohydroxyquinoline	100 mg.
Phenylmercuric Acetate	3 mg.
Sodium Lauryl Sulfate	3 mg.
Lactose	430 mg.
Dextrose Anhydrous	430 mg.
Potassium Aluminium Sulfate	14 mg.
Papain	20 mg.
"Amfrecin" douche powder:	
Sodium Lauryl Sulfate	12·5 mg.
Papain	50·0 mg.
Citric Acid	0·8 mg.
Lactose	4·1 mg.
Methyl Salicylate	12·5 mg.
Menthol	12·5 mg.

The patient douches herself with Amfrecin (1 drachm per quart of water), and the vagina is then insufflated with one ounce of Baculin powder, care being taken to "balloon" the vagina. She now inserts 2 one-gram tablets of Baculin twice daily, and closes the vagina with a pledget of cotton wool. The vagina is insufflated twice a week. In addition, Amfrecin douching before and after coitus is recommended with subsequent insertion of two Baculin tablets. The use of a condom by the husband is also advised. This treatment is carried out through at least one menstrual cycle but results seem to indicate that longer treatment is advisable. During menstruation douching should be employed 2–3 times a day followed by insertion of the tablets and vaginal stopper.

Two hundred patients were treated and 85 per cent were free of trichomonads and candida within "a few days", 13 per cent required "a slightly longer time". The failures are attributed to lack of co-operation by the patient or her husband. Six patients had a recurrence but responded to a second course of treatment.

[There is no record of bacteriological examination

before onset of treatment, and it would seem that in view of the length of the course, the treatment does not seem to be more effective than Flavine-Acetarsol pessaries with vinegar douches.]

D. C. A. Bevis

57. **The Problem of Dyspareunia.**

By A. M. CLAYE. *N.Z. med. J.*, **54**, 297–306. June 1955. 6 refs.

This paper to the first New Zealand Congress of Obstetrics and Gynaecology provides a thoughtful discussion on this subject, and it is not really possible to abstract it adequately. It is recommended that the original paper should be consulted by those interested.

Dyspareunia is a partnership trouble and the husband and the wife should be seen separately, and without any third person present. In this way the story of the couple may be elicited more clearly. In many gynaecological clinics the atmosphere is such that a discussion with these patients is not conducive to obtaining their confidence. He deals briefly with the organic causes of dyspareunia and goes on to discuss psychological problems.

Opening the discussion, R. G. Worcester dealt in greater detail with organic causes of dyspareunia. He found that only 6 out of 54 patients with this complaint had psychological causes for their trouble. He gave in detail his method of treating patients with a small introitus, and then mentioned other conditions which may cause dyspareunia.

L. Woodrow Cox

58. **The Tubal Factor in 1,122 Successful Sterility Cases.**

By A. GRANT and R. MACKEY. *N.Z. med. J.*, **54**, 307–321. June 1955. 11 tables. 15 refs.

In this paper to the first New Zealand Congress of Obstetrics and Gynaecology, the authors show that since 1946 1,122 patients attending the Sterility Clinic of the Women's Hospital, Crown Street, Sydney, have become pregnant. The absolute pregnancy rate in this clinic is about 33 per cent and the relative pregnancy rate about double that figure. Of the patients who became pregnant, 569 had normal tubes, as shown by the Rubin test, or a salpingogram, or both. In this group there were 46 miscarriages (10·8 per cent) and 7 ectopic pregnancies (1·5 per cent).

Tubal spasm was present in some form in 211 cases becoming pregnant (18·7 per cent). An initial pressure of over 100 mm. of mercury by Rubin's test, or a negative Rubin test followed by a normal salpingogram was recorded as evidence of spasm. In 25 cases where there was no evidence of tubal patency but pregnancy occurred the spasm was severe. In this group there were 16 miscarriages (9·2 per cent) and 4 ectopic pregnancies (2·3 per cent).

Tubal stenosis was present in 63 patients who became pregnant. The Rubin test in these patients showed the passage of gas at 100 m. of mercury with minimal or no peristalsis. There were 7 miscarriages and 1 ectopic in this group.

Pregnancy occurred 74 times in women whose tubes showed pathological changes. In 28 of these cases there was a normal Rubin test, but the salpingogram showed one or both tubes to be pathological. In 56 of these cases there were fimbrial adhesions and in 11 unilateral hydrosalpinx. There were 8 miscarriages and 8 ectopic pregnancies (10·8 per cent) in this group.

There were 38 pregnancies in patients who had blocked tubes which received pressure treatment. In 290 cases treated, 77 became patent and 38 became pregnant (12·8 per cent).

There were 30 pregnancies in patients who had tubo-plastic operations. There were 122 of these operations. Eighty-two had patent tubes after operation and 30 (25 per cent) became pregnant. There were 3 abortions and 2 ectopics in this group.

There were 26 cases of genital tuberculosis discovered during the investigations, an incidence of 0·5 per cent among the sterility patients in Australia.

The authors conclude with a note on the use of the culdoscope. This instrument is used before any operation of tubo-plastic nature is attempted. Because of their success with the use of this instrument, it is recommended that it should be used in all cases where no pathology is found and where the patient fails to become pregnant in three months.

Opening the discussion, J. W. Johnstone analyzed 960 sterility cases from his private practice. There were no sperms present in 70 per cent of these cases. Failure of ovulation occurred in 2·3 per cent. The tubes were completely blocked in 16 per cent. These three factors, seminal, ovulational and tubal, account for 25 per cent of the cases of absolute sterility. He mentions the importance of psychosomatic factors in couples with sterility.

The results of 27 tubal implantation operations are given. Pregnancy occurred in 8 cases, but was unsuccessful in 3 due to abortion (2) and interstitial implantation (1). Of the 5 successful cases, 2 cases each had 2 children and 1 case has 3 children.

A. G. Cumming continued the discussion and detailed the technique of salpingography. He made the point that, when an experienced gynaecologist injects the opaque medium, the percentage of cases of spasm is much lower, probably due to the more gentle manipulations which do not hurt the patient as much as if an inexperienced operator is performing. Of 157 cases he found normal tubal patency in 86·7 per cent. Apparent bilateral tubal occlusion was seen in 16 cases or 8·8 per cent. He attributes this low figure to the careful preparation of the patient and gentle technique of the procedure.

L. Woodrow Cox

59. **The Problem of Female Frigidity.** (Le problème de la frigidité féminine.)

By I. BERNARD and A. RENOU. *Gynéc. prat.*, **6**, 243–262. 1955. 69 refs.

Frigidity is defined as failure to obtain a vaginal orgasm with a hetero-sexual partner. This symptom is found among 25–50 per cent of French women, and its importance is stressed. Frigidity may occur in several

forms: (1) Complete, in which there is a complete absence of libido. This may be due to indifference or to inhibition. (2) Incomplete, in which frigidity is associated with a normal sexual impulse. (3) Partial, in which libido is normal but vaginal orgasm rarely achieved. (4) Physiological. It is not usual for vaginal orgasm to occur early in married life. Its occurrence may be influenced by the stage of the menstrual cycle and by pregnancy. The advent of the menopause usually has little effect.

The aetiological factors underlying frigidity are classified as follows: (1) Symptomatic frigidity, due to (*a*) systemic disease such as chronic infections, drug or alcohol intoxication, etc., (*b*) gynaecological disease causing dyspareunia, (*c*) endocrine disease, of the ovary, pituitary, suprarenal or thyroid glands, and (*d*) psychological disorders. (2) Frigidity of unknown aetiology. This is possibly associated with either an endocrine imbalance or a psychic disturbance in relation to coitus.

Treatment should be aimed first at improving the general health. The primary cause of symptomatic frigidity should then be dealt with. The possibility that frigidity is due to errors in the part of the male partner should be remembered. It is often necessary to seek the aid of a psychiatrist, especially in cases of unknown aetiology. It is in the last group that the authors have used intramuscular injections of oestrone 1 mg. and testosterone 25 mg. in an oily base. They claim satisfactory results.

Geoffrey Dixon

60. **Gonorrhoea in Female Contacts.**

By L. P. GOLDSTEIN. *Obstet. Gynec.*, **6**, 193–204. Aug. 1955. 27 refs.

Clinical material comprising this report consists of 538 women examined and treated at the venereal disease centre of the Philadelphia department of public health. They were referred because an investigation disclosed them to be the sex contacts of men treated for acute urethritis. All female patients suspected of being infected with gonorrhoea were examined and given intramuscular penicillin (1·2 million units). They were instructed to report back in 1 week.

At the follow-up clinic, if smear cultures previously taken were negative for gonococci, the patient was discharged. If either was positive, it was retaken, the patient being re-examined and given more penicillin. Patients known to be contacts of syphilitics were given streptomycin instead of penicillin (9·5 per cent were in this category).

Positive cultures and/or smears for gonococcus were found in 20·6 per cent of the 538 cases. Most authors agree on the difficulty in bacteriological diagnosis. Cultures of gonococcus have been grown from apparently normal cervices whilst the organism at times cannot be isolated from grossly inflamed cervices.

In general the gynaecological diseases occurring in patients with proved gonorrhoea were similar to those manifested by contacts with negative findings, but in the 111 cases of proved gonorrhoea there were 80 (72 per cent) with cervicitis and 17 (15 per cent) with adnexal involvement.

Of the 111 cases of gonorrhoea, 92 returned for follow-up examination. In 85 per cent of these smears and cultures were negative after 1 dose of penicillin.

J. G. Dumoulin

NEW GROWTHS OF THE REPRODUCTIVE ORGANS

61. **Sarcoma of the Uterus.**

By L. HERMAN and D. N. BARROWS. *Obstet. Gynec.*, **6**, 18–37. July 1955. 25 refs.

This review of the literature on sarcoma of the uterus includes 9 cases treated at the New York Polyclinic. This is an incidence of 0·09 per cent of all gynaecological admissions. Whilst sarcoma botryoides occurs in infants and children, other sarcomas of the uterus are most common in the menopause and post-menopausal period. The condition may arise from the muscle cells of the uterus or of a myoma, from connective tissue or from the walls of the blood vessels. Sarcoma botryoides may arise from mesodermal Müllerian tissue. Myomatous sarcoma is the most frequent type, the lesion being near the centre of the myoma, and being either necrotic or resembling hyaline or cystic degeneration. Sarcoma in the wall of the uterus may be diffuse or nodular. Endometrial sarcoma may be diffuse and polypoid.

There is a definite relationship between the development of sarcoma and the presence of myomas. However, the high incidence reported by earlier authors probably included the cellular myomas. Some authors report that radium or X-ray is an aetiological factor in the development of sarcoma.

Symptoms are a rapidly enlarging pelvic mass, irregular bleeding and abdominal pain, although the diagnosis is seldom made pre-operatively.

Total hysterectomy with removal of adnexa is the most general treatment in the absence of metastases. The use of X-ray therapy as adjunctive treatment is open to question as the main spread of the disease is by blood dissemination. The prognosis, in general, is not good.

J. G. Dumoulin

62. **Uterine Sarcomas.**

By G. A. WEBB. *Obstet. Gynec.*, **6**, 38–50. July 1955. 41 refs.

Forty-two cases of uterine sarcoma are reviewed by the author from San Francisco comprising 1·8 per cent of all uterine malignancies seen. They are divided as follows: leiomyosarcoma 22, endometrial 7, mixed mesodermal 8, and carcinosarcoma 5. The incidence was no higher in parous than nonparous women. Early surgical treatment offers the best hope of cure, and surgery plus irradiation is advised for endometrial stromal sarcoma, mixed mesodermal sarcoma, and possibly carcinosarcoma. The 5-year cure rate in the series is 28 per cent.

[The author of this article gives many of the features

of this condition which are discussed in the review of the subject by Herman and Barrows (Abstr. No. 61).]

J. G. Dumoulin

63. **Sarcoma of the Uterus.**

By J. W. WALSH. *Obstet. Gynec.*, **6**, 420–429. Oct. 1955. 9 refs.

The author presents 11 cases of sarcoma of the uterus, divided into endometrial sarcoma, myogenic sarcoma, and carcinosarcoma. This represents 4·6 per cent of the uterine malignancies seen. One case was 27 years old, the remainder being over 47. Nine cases complained of vaginal bleeding, 6 of abdominal pain, 3 of an abdominal mass, and one of urinary frequency. There was some degree of uterine enlargement in all. Treatment was by a variety of operations. Seven patients died within 1 year and only one (with a well-encapsulated sarcoma within a fibroid) survived longer than 5 years.

J. G. Dumoulin

64. **A Unique Form of Leiomyoma of the Uterine Body.** (Eine einzigartige Form von Leiomyoma corporis uteri.)

By J. KRIZ and J. TOBISKA. *Gynaecologia, Basel*, **140**, 80–89. Aug. 1955. 4 figs. 20 refs.

A woman of 66 was operated on for a uterine fibroid, and a tumour the size of a foetal head was removed. It appeared to be a vascular, encapsulated myoma.

The histological appearances of the tumour were very remarkable and probably unique as it proved to be a benign mesenchymal tumour of unusual structure. The form of the cells was long, branching and anastomosing; fibrillary processes were seen in them.

It has not been found possible to trace any account of a similar tumour in the literature. The tumour itself was shown to several histologists and was diagnosed by them as follows: leiomyoma, 5 times; papilloma, twice and adenocarcinoma once.

Josephine Barnes

65. **A Functional Test for Differentiation between Atypical Hyperplasia and Early Carcinoma of the Body.** (Distinction fonctionnelle entre l'hyperplasie atypique et le cancer du corps à son début.)

By H. HUSSLEIN. *Gynéc. prat.*, **6**, 237–241. 1955.

Every practising histopathologist knows that the differentiation between atypical hyperplasia and early carcinoma of the body is difficult. The author has evolved a clinical test which, although it involves a little delay, does provide an absolute differentiation between hyperplasia and carcinoma. He considers that this test is particularly important when suspicion of carcinoma is raised during the reproductive phase. Only 0·56 per cent of the author's cases of carcinoma were in this age group and he feels that the higher figures often given are due to confusion with hyperplasia.

The test consists of giving testosterone in doses of 500–2,000 mg. in the first 2–3 months after the initial curettage. A second curettage is performed 6 months after the first. In cases of hyperplasia the endometrium will show atrophy, but carcinoma will still be present, although its progress may have been slowed.

The author cites seven cases in which the initial curettage gave endometrium of uncertain histological appearance. In these cases an additional curettage was performed 3 months after the first in order to discover the effect of testosterone in high dosage on the growth of carcinoma. In all cases no endometrium was obtained at this time. A third curettage was then performed 6 months after the initial one, no further treatment being given. Five cases showed normal pictures for the phase of the menstrual cycle. Two showed undoubted carcinoma.

An 8th case report is appended to the article. A curettage was performed for amenorrhoea in an infertile woman of 29. The endometrium was reported as "probable carcinoma". One thousand mg. of testosterone were given and six weeks later a curettage showed a proliferative endometrium with poor gland formation, but without suspicion of carcinoma. Three months, in which no treatment was given, were then allowed to lapse before a third curettage was performed. This showed changes very suspicious of carcinoma. During the next six weeks a further 1,000 mg. of testosterone were given. Curettage after this showed a thin endometrium with no suspicion of carcinoma. Four months later a fifth curettage performed for intermenstrual bleeding showed certain carcinoma. The operative specimen showed carcinomatous changes in the right cornual region.

The author claims that this case, like the others, shows that although testosterone may slow down the rate of progress of early carcinoma of the body, it does not produce complete regression. In advanced cases it has no effect. On the other hand, high dosage of testosterone does cause regression and atrophy of the hyperplastic endometrium.

Geoffrey Dixon

66. **On the Influence of Follicular Hormone upon Carcinoma of the Uterine Body.** (Der Einfluss des Follikelhormons auf das Corpuscarcinom.)

By H. HUSSLEIN and E. SCHÜLLER. *Arch. Gynäk.*, **187**, 20–37. 1955. 14 figs. 22 refs.

The combination of adenocarcinoma and glandular cystic hyperplasia, and the frequent occurrence of adenocarcinoma after prolonged administration of oestrogen or in women with a delayed menopause, suggest that carcinoma of the uterine body may be associated with increased oestrogenic stimulation. Conversely, carcinoma of the body is rare after surgical castration.

The authors do not believe that follicular hormone is itself carcinogenic, but they postulate that it stimulates the growth of a latent neoplasm. They investigated 601 cases of adenocarcinoma diagnosed between 1925 and 1950 (57 cases were Stage O and 544 cases Stages I and II). Of these 179 (32·9 per cent) showed pronounced oestrogenic stimulation, and in 50 (9·1 per cent) no such effect was demonstrable. The majority of women (315 or 58 per cent) gave inconclusive histological evidence, but the authors maintain from anamnestic data (oestrogen administration and the absence of corpora lutea in

women who were of the reproductive age, that many of these, despite the absence of histological confirmation, had been under the influence of oestrogens. They believe that follicular hormone is certainly a very important, though not the only, growth stimulating factor of adenocarcinoma. The authors state that testosterone given in sufficient amounts causes regression of *every* glandular hyperplasia, however atypical, whereas carcinoma cannot be influenced by this treatment. It is suggested that testosterone may be used to differentiate between atypical hyperplasia and malignancy. Two relevant cases are quoted.

The authors recommend the following prophylactic measures: (1) elimination of all known carcinogenic substances, (2) avoidance of prolonged oestrogenic activity by cyclical variation with progesterone or suppression with testosterone, (3) local treatment of hyperplasia, and treatment with testosterone, (4) avoidance of prolonged oestrogen therapy, (5) surgical castration rather than the induction of the menopause with X-rays, (6) administration of vitamin B to maintain adequate liver function.

E. Wachtel

67. **Papillomas of the Uterine Cervix—Their Malignant Potentiality.**

By R. W. KISTNER and A. T. HERTIG. *Obstet. Gynec.*, **6**, 147–161. Aug. 1955. 6 refs.

Squamous papillomas of the cervix are very rare. This paper concerns 14 such cases found in 46,500 diagnoses of cervical tissue at Boston. Five of these are described as pregnancy papillomas which were usually found on routine vaginal examination during early pregnancy, required no treatment, and disappeared spontaneously during the puerperium. Two cases of condyloma acuminatum of the cervix are described. It is presumed to be of viral origin, and is associated sometimes with a trichomonal infection. In pregnancy the lesion undergoes marked hypertrophy. The remaining 7 cases are true neoplastic papillomata occurring in the post-menopausal and non-pregnant patient. They are potentially or actually malignant. In one of the authors' cases the lesion masked an underlying papillary squamous invasive carcinoma. In 2 others malignancy was diagnosed erroneously and radiation therapy administered.

J. G. Dumoulin

68. **Carcinoma of the Cervix.**

By G. J. S. FISHER. *N.Z. med. J.*, **54**, 371–376. June 1955. 9 refs.

The results of treatment at the Auckland Hospital are presented in this paper to the first New Zealand Congress of Obstetrics and Gynaecology. It was shown that a marked improvement occurred following the centralization of cases under one team. The improvement was obtained in cases of Stage I and II, but there was no improvement in cases of Stage III and IV. These cases were treated with radium but the exact technique was not detailed. It was considered important to treat secondary anaemia by giving pre-operative blood transfusions. When infection was present deep X-ray was given before the radium treatment. When a reactionary temperature occurred following the insertion of radium, the radium was removed and replaced when the inflammation had subsided a few days later. Of 170 cases treated between 1940 and 1945, 51 are still alive and symptom-free; 110 cases have died but 8 of these were symptom-free for 5 years or more.

The discussion was opened by A. M. Claye. He stated first that in the treatment of malignant disease we have to weigh what is best for the patient and also what is best for ourselves. What is best for one surgeon to do for one patient may not be the same as what it is for another to do for a different patient. There is no unanimous view in the treatment of carcinoma of the cervix as to whether radical operation or irradiation is better. One can admire the technique and results of both those who use radium and those who tackle radical surgery. He pointed out that however great the operability rate may be, there must be many cases for which radiation is the only possible therapy. Also the number of surgeons capable of carrying out the radical operation for carcinoma of the cervix in a first class manner is limited. There is a strong case for handing over these cases to one team in a centre when surgery has been agreed upon.

The relations between gynaecologist and radiotherapist are important. The writer believed that the gynaecologist, being more familiar with the anatomy of the genital tract, is the best person to insert radium. In some of these cases there is great difficulty in finding the external os and inserting the radium properly. Also, for teaching purposes, it is important that the student should see a number of cases of cancer amongst the ordinary run of gynaecological cases.

L. Woodrow Cox

69. **Invasive Carcinoma of the Cervix in Young Women.**

By D. G. DECKER, R. E. FRICKE and J. H. PRATT. *J. Amer. med. Ass.*, **158**, 1417–1420. Aug. 20, 1955. 7 refs.

Invasive carcinoma of the cervix in young women presents many special problems, and although there is a widespread clinical impression of increased virulence in the younger age group the gynaecological complaints of young women are often viewed with less suspicion than those of the older age group.

A total of 1,451 patients with carcinoma of the cervix were seen at the Mayo Clinic over the 10 years up to 1949. Of these 169 cases were 35 years of age or younger and they form the subject of this investigation. Thirteen cases were in the age group from 20–25 years, 33 cases from 26–30 years, and 123 cases from 31–35 years. At the Mayo Clinic it is the opinion at present that radium and roentgen therapy affords the best primary approach to the cure of invasive carcinoma of the cervix, and 66·3 per cent were treated in this way. Because young women with early lesions are usually good surgical risks they are more likely to receive primary surgical treatment than those in the older age group and surgery alone was used in 7·1 per cent of the 169 cases. Surgery with various combinations of radiotherapy was used in 16·6 per cent of the cases. A detailed analysis of the treatment and follow-up of the three groups is given,

and the relative 5-year survival rate of the whole series was 53·5 per cent. This figure includes a group of 36 cases where the disease was far advanced or had been modified by treatment elsewhere and only limited palliative treatment was attempted.

The authors conclude that carcinoma of the cervix is not more malignant in young women, and that the role of surgery is somewhat greater than in the older age group. Radical hysterectomy and lymph node dissection is considered to be more satisfactory than the Taussig operation (which has not been performed at the Clinic since 1949). There is still grievous delay in diagnosis due to misinterpretation of relatively minor symptoms, and it is here that the greatest advance could be made.

D. W. James

70. **The Diagnostic Accuracy of the Vaginal Smear in Cancer of the Uterine Cervix.**

By O. KJELLGREN. *Acta obstet. gynec. scand.*, **34**, 249–268. 1955. 10 figs. 44 refs.

Three thousand vaginal smears were examined at 2 gynaecological hospitals in Gothenburg, Sweden. This series included 257 cases of carcinoma of the uterine cervix, as proved by biopsy. Of these cases, 244 (95 per cent) were squamous cell carcinomas, and 13 (5 per cent) were adenocarcinomas. Thirty-eight (15 per cent) of the tumours were of endocervical origin. In 241 out of the 257 cases a correct diagnosis was made from the vaginal smear.

A detailed study is presented of the incidence of false negative results, amounting to $6 \cdot 2 \pm 1 \cdot 5$ per cent. If the cases are omitted in which the patients had received radiological or surgical treatment (including cautery) shortly before the smear was taken, the false negative error drops to $2 \pm 0 \cdot 9$ per cent. A false negative diagnosis was given in 38 per cent of the 13 adenocarcinomas, and in 4·5 per cent of the 244 cases of squamous cell carcinoma. This difference appears to be large but is not statistically significant. False negative results were obtained in 24 per cent of the 38 cases of endocervical cancer but only in 3·2 per cent of the 219 cases of cancer of the portio vaginalis. This difference is statistically significant. The author concludes that it should be possible to reduce the high incidence of false negative results among cases of endocervical cancer by obtaining material for examination from the endocervix instead of from the vaginal pool.

N. Alders

71. **The Statistical Problem of Errors Occurring in Reports of Vaginal Smears in the Early Diagnosis of Carcinoma of the Cervix. Biopsy of the External Os and the Criteria Deduced from a Study of the Chromosomes in Intra-epithelial Epitheliomas.** (Problèmes statistiques des erreurs apportées par les frottis vaginaux dans le diagnostic précoce du cancer du col: biopsies orificielles et critères chromosomiques des épithéliomas intra-épithéliaux.)

By R. MORICARD. *Gynéc. Obstét.*, **54**, 294–331. 1955. 7 figs. 53 refs.

The writer's material concerned 12,043 women seen at the Broca Hospital at Paris in 4 years. Out of these 270 cases of cancer were diagnosed which is approximately 2 per cent. The global mortality figure for uterine cancer is in the neighbourhood of 2 women for every 100 dying.

Dr. Moricard asks what is the value of certain statistics where one only pretends that out of 1,000 living and apparently healthy women there would be 10–20 cases of unrecognized cancer of the cervix. The diagnosis of cancer of the cervix by vaginal smears seems to lead us to admit a frequency very much greater than is really the case.

In the experience of certain cytologists, 1 in 50 of healthy women will develop an asymptomatic slowly developing cancer.

When gynaecological investigations are properly carried out, the systematic use of vaginal smears is, in the opinion of the writer, quite useless for accurate diagnosis of early cancer of the cervix.

On account of the frequency of errors in interpretation, vaginal smears can be dangerous, in that often they cause serious worry to a patient or surgeon when the disease in fact does not exist; furthermore the surgeon may be forced to carry out useless treatment which is not without risk.

From the national point of view, the writer advises that in the "Prevention of Cancer Campaign" of the Society for Social Security in France, all practitioners should be persuaded to carry out the Schiller test. The iodine-negative areas should be biopsied and colposcopy by an expert may be very helpful. Biopsies should be carried out most often in the region of the external os. The interpretation of the biopsies is usually conclusive if the anatomo-pathological criteria are well known.

In Moricard's opinion it is only by Schiller's test and biopsy that differentiation between benign and malignant conditions can be made. In practice dysplasia of the cervix should be treated by the diathermy needle, and surgical intervention is indicated for carcinoma *in situ*.

[This is a *very* comprehensive paper of 36 pages by probably the best gynaecological pathologist in France.]

D. Maxwell

72. **New Concepts in the Treatment of Carcinoma of the Cervix.**

By J. HARBUTT. *N.Z. med. J.*, **54**, 356–370. June 1955. 14 tables. 35 refs.

The following general principles were stated at the outset: firstly, treatment must be individualized; secondly, the care of these patients should be centred in the hands of a limited number of clinicians and, thirdly, there should be a well organized follow-up clinic. After mentioning the value of vaginal smears and emphasizing the importance of carcinoma *in situ*, the author goes on to discuss in detail the role of irradiation therapy and surgery in the treatment of cervical cancer. After reviewing a number of recent papers on the results of treatment by radiotherapy, the author suggests that treatment in the majority of cases is safer with radiotherapy than it is with surgery. He believes that surgery has its place in treating those cases where radiotherapy

has failed. In these cases surgery is also likely to fail because they are the more malignant types of growth but nevertheless surgery will salvage a small percentage of these patients. The important question is when a case is to be regarded as an irradiation failure. The writer suggests that a case with persistently positive smears or positive biopsy 6 weeks after completion of treatment and confirmed in a further 6 weeks, should be regarded as a failure of treatment.

The place of pelvic exenteration, pre-operative irradiation, and combined radiotherapy and iliac lymphadenectomy are also discussed.

L. Woodrow Cox

73. **Radiation Dosimetry in the Treatment of Carcinoma of the Cervix Uteri by Intraparametrial Radioactive Gold and Radium.**

By M. TER-POGOSSIAN and A. I. SHERMAN. *Radiology*, **74,** 116–122. July 1955. 5 figs. 1 table. 22 refs.

Adequate radiation of the local uterine lesion is obtained by almost every form of therapy but the parametrium often receives ineffective dosage. Analysis of surgical statistics reveals the presence of lymph node involvement from 25 to 50 per cent in operable cases, but there are several reports which indicate that it is possible to destroy regional tumour cells by radiation. However, difficulty is encountered in delivering high dosage to the lymph node areas and an attempt has been made, therefore, to effect adequate parametrial radiation by the intraparametrial injection of a colloidal suspension of radioactive metallic gold. The method is employed in conjunction with intracavitary radium. The mode of action of the radioactive gold is assumed to be threefold: (1) beta-ray irradiation of the volume of tissue permeated by the gold, (2) intense irradiation of the reticulo-endothelial system into which the gold selectively concentrates, (3) gamma-ray irradiation of a volume of tissue extending beyond the area of gold infiltration. The colloid was rendered radio-opaque by admixture with 20 per cent diotrast and subsequent roentgenograms showed that the area of possible lymph node involvement located along the obturator nerves and around the iliac vessels was covered by the injection and that the volume of tissue occupied by the gold did not change appreciably within two weeks. Seventy mc. of radioactive gold having an average life of 100 hours was injected into each parametrium and the volume of tissue covered estimated to be about 500 c.cm. on each side. The sum total of radiation was as follows:

Radiation Contribution	Cervix	Bladder	Rectum	Mid-parametrium
Gold-198 gamma-rays	1,200	1,100	1,200	2,250
Radium r units ..	12,000	6,000	5,000	3,350
Total r units ..	13,000	7,100	6,200	5,600
Gold-198 beta-rays	—	—	—	10,600

The total radiation delivered to the lateral parametria by the combined form of therapy comprised 5,600 gamma roentgens derived from the intracavitary radium and 10,000 to 11,000 rep. from the radioactive gold.

J. H. Mulvany

74. **Perforation of the Bladder by Ovarian Dermoid Cysts.** (Kystes dermoïdes de l'ovaire perforés dans la vessie.)

By A. GILLOZ. *J. Urol. méd. chir.*, **60,** 906–923. 1954. 56 refs.

The author has collected from the literature 25 cases of ovarian dermoid cysts opening into the bladder. Perforation of the bladder takes place usually as a result of inflammation in the cyst. Once perforation has taken place the contents of the cyst are found in the urine. Occasionally there are symptoms of chronic cystitis. A stone may form in the bladder round a matrix of hair or teeth. A cystoscopy confirms the diagnosis. Operation is best performed through the peritoneal cavity.

J. H. Carver

75. **Endometriosis.**

By W. HAWKSWORTH. *N.Z. med. J.*, **54,** 334–345. June 1955. 8 tables. 11 refs.

The pathology of endometriosis is briefly considered. The records of 167 cases diagnosed as endometriosis at the Radcliffe Infirmary, Oxford, were presented. There was histological proof of the condition in 107 cases and only these proven cases were used in the succeeding tables. The following symptoms were recorded in this series: menorrhagia 69·1 per cent, dysmenorrhoea 47·5 per cent, dyspareunia 31·3 per cent, rectal pain 11·2 per cent and intermenstrual pain (abdominal pain and backache) 60 per cent.

There were 96 married patients in the series and 30·2 per cent had never been pregnant. That is, 69·8 per cent of the patients became pregnant one or more times.

The physical signs and the diagnosis of endometriosis are discussed in detail. The results of treatment of the patients are also discussed in detail. Radical surgery was undertaken in 80 patients. Sixty-eight (85 per cent) were completely free from pain of any description. Another 8 (10 per cent) complained of backache after the operation, so that 95 per cent of the cases operated on could be considered to have good relief from the pain associated with endometriosis. Fourteen complained of menopausal symptoms.

Conservative treatment was undertaken in 20 patients, these women having attended primarily for sterility. Pre-sacral neurectomy, resection of chocolate cysts and diathermy of the endometriotic tissue were the operations performed. Eight subsequently became pregnant and produced between them 10 living children.

L. Woodrow Cox

76. **On the Origin of Endometriosis.**

By J. S. MCVEIGH. *N.Z. med. J.*, **54,** 346–349. June 1955. 7 refs.

A new theory on the origin of endometriosis is presented. It is suggested that the cells of the corona radiata

which are shed with the ovum at ovulation may, under certain hormonal conditions, be capable of reproducing true endometrium in ectopic situations. These cells are of the same morphological origin as those of normal endometrium. They are composed of downgrowths of the germinal epithelium surrounding the ovary and have the same morphological origin as the cells which line the whole Müllerian system including those lining the uterine cavity—the endometrium. If these cells become grafted on pelvic peritoneum and begin to grow, they may produce ectopic deposits of endometrium.

The writer suggests that the occasional case of endometriosis in an abdominal scar has occurred because an ovum with its corona radiata has been picked up on a swab or instrument and implanted in the abdominal wound. This type of scar endometriosis rarely if ever follows Caesarean section because there are no ova in the vicinity at that time.

The common occurrence of endometriosis in the ovary is not surprising if one admits that cells of the corona radiata can change to endometrium.

L. Woodrow Cox

77. **Endometriosis and Adenomyosis.**

By A. H. FOATE. *N.Z. med. J.*, **54**, 350–355. June 1955. 1 fig. 4 tables. 5 refs.

This is a contribution to the first New Zealand Congress of Obstetrics and Gynaecology in which the author reviews 129 cases treated at Oxford. Details are given of the site of the lesions, associated pathological findings, symptomatology and clinical signs. The contrasting symptoms and physical findings in adenomyosis and endometriosis are recorded. Endometriosis was correctly diagnosed before operation in 62 per cent of cases. It was most often missed when fibromyomata were also present, as these obscured the pelvic findings. With adenomyosis only 11 per cent were diagnosed before operation, so that this was most commonly a histological diagnosis made on uteri removed for some other reason.

R. Charlton opened the discussion. He supported the previous speakers in conservative surgery in patients under 35. On the other hand, he believed that radical surgery is the most satisfactory method of dealing with this complaint in patients over 35. He had used deep X-ray therapy in many cases when surgery was contraindicated or had failed. The dose used was 1,000–1,200 r and the radiation was directed towards the ovaries.

L. Woodrow Cox

78. **Granulosa-Theca Cell Tumours and Endometrial Carcinoma.**

By H. MANSELL and A. T. HERTIG. *Obstet. Gynec.*, **6**, 385–394. Oct. 1955. 12 refs.

Late Recurrence of Granulosa Cell Tumours.

By S. C. SOMMERS, O. GATES and I. I. GOODOF. *Obstet. Gynec.*, **6**, 395–398. Oct. 1955. 7 refs.

The first of these studies concerns the relationship between granulosa-theca cell tumours and endometrial carcinoma. Eighty cases of granulosa cell tumour which occurred at the Free Hospital for Women, Brooklin, and the Harvard Medical School, Boston, between 1907 and 1953 were surveyed. Out of 75 cases, carcinoma *in situ* was found in the endometrium in 7 cases, and carcinoma in 11.

A histological estimation of the presumed oestrogenic activity of the tumours was made. Those considered "active" were more often accompanied by endometrial activity. There were 5 endometrial carcinoma *in situ* and 8 carcinoma in the "active" group of tumours.

The second report gives details of recurrences of malignant granulosa cell tumours in 2 women, 14 and 26 years after their first operative diagnosis.

J. G. Dumoulin

OPERATIONS

79. **The Securing of Tubal Patency by Tubal Injections of Hydrocortisone.** (Désobstruction tubaire par injections d'hydrocortisone "in situ".)

By J. R. BENNOUN. *Gynéc. prat.*, **6**, 263–266. 1955.

Local therapy with hydrocortisone in the presence of inflammation produces the following effects: (1) Analgesia, by a secondary local anaesthetic action. (2) Anti-inflammatory, by producing a fall in both the aminotripeptidase and leucocyte levels. (3) A lessening of fibrosis, sclerosis and adhesion formation in the healing phase.

Because of these facts the author was led to try the effect of local hydrocortisone on tubal obstruction. Cases chosen had all been treated for at least three years without success, all had at least three negative insufflations and showed obstruction on hysterosalpingography. Special care was taken to exclude cases of tubal spasm.

Hydrocortisone was injected into the tubes by a special technique (which is described in considerable detail). Twenty-nine cases were treated. Seventeen (58 per cent) subsequently showed tubal patency for two to three months, five (17 per cent) remained patent. Only one pregnancy has occurred, but the author points out that any technique which merely restores patency to a damaged tube is no guarantee of the restoration of fertility.

Geoffrey Nixon

80. **Results Obtained in 150 Tubal Insufflation Tracings.** (Resultados obtenidos en 150 persuflaciones utero-tubáricas quimográficas.)

By J. A. CABELLO and V. CHIONG. *Obstet. Ginec. lat.-amer.*, **13**, 154–157. May 1955.

The authors found that obstruction of varying degrees in the Fallopian tubes was the commonest cause of female sterility. They recommend that insufflation of the tubes and hysterosalpingography should be performed in every case, and repeated until a definite opinion of the condition of the tubes is established.

In a series of 80 women investigated along these lines, 150 tracings were recorded, the greatest number for any one patient being 11. Thirty-eight women were found to have patent tubes, but of these only 21 had what the authors consider perfectly normal tubes. The remaining 17 of this group presented variations in the frequency

and amplitude of the tubal contractions. Of 18 cases of occlusion, 4 were reported to have become patent by repeated attempts at insufflation.

Stenosis was found in 12 cases, and was diagnosed by patency occurring at pressures between 140–180 mm./Hg, but without any evidence in the tracing of tubal contractions; whilst spasm was diagnosed by the subsequent appearance of oscillations, although the pressure required to overcome the spasm was of a higher order, varying between 150–200 mm./Hg.

John F. Foulkes

81. **New Fascia Plastic Repair of Enterocele.**

By R. C. Austin and E. F. Damstra. *Surg. Gynec. Obstet.*, **101**, 297–304. Sept. 1955. 6 figs. 15 refs.

A series of 73 enteroceles studied at Dayton, Ohio, is described. Enterocele is defined as any herniation of small intestine into the vagina; primary enterocele as a herniation through the posterior wall of the vagina behind the cervix; secondary enterocele as a herniation through the floor of the pelvis found only after complete hysterectomy.

The aetiology of enterocele is discussed. It is considered that the true primary enterocele is a small, narrow, thin-walled sac, probably congenital, which forms behind the cervix and lies between the posterior vaginal wall and the anterior rectal wall in the recto-vaginal septum. The cul-de-sac of Douglas is below such a hernia and is not connected with the enterocele. Enteroceles developing after pan-hysterectomy may be of the primary or of the secondary type. In the 29 cases reported, the abdominal route had been employed in 9 and the vaginal route in 20.

The authors discuss the classical methods for repair of enterocele and then describe their own fascial plastic operation. The latter is considered particularly applicable to herniations through the pelvic floor, especially when there is little or no support from the cardinal ligaments and also for the repair of large primary type enteroceles. The operation is entirely a vaginal procedure and in essence it is an extension of the George Gray Ward perineorrhaphy. The essential features of the procedure are:

(1) The complete bi-section of the vaginal wall anterior and posterior and separation of the anterior fascia from the vaginal skin.

(2) The separation of Colles fascia from the urogenital diaphragm as high up as possible.

(3) The attachment of the Colles and superficial fasciae in a single layer to the anterior vaginal fascia at the vault.

(4) The use of fascia lata sutures to co-opt the Colles fascia and the anterior vaginal fascia.

This technique completely closes the vagina against descent of small intestine, yet preserves a functional organ. It has been used for a total of 21 enteroceles. The time since the operation was developed is too short and the cases too few to permit a final evaluation of the procedure but to date the results have been very encouraging.

John P. Erskine

UROLOGY

82. **Urethral Diverticulum in the Female.**

By R. D. Dunn. *West. J. Surg. Obstet. Gynec.*, **63**, 689–694. Nov. 1955. 15 refs. 4 figs.

In recent years it has become apparent that this condition is more common than was previously thought. The diverticula may be congenital, derived from Gartner's duct or the para-urethral glands, or acquired through infection of, or trauma to the para-urethral glands. Their size varies from 3 to 8 cm. diameter and there is sometimes no plane of cleavage around them. They may be multilocular, and although usually caudad to the urethra, they may extend round either or both sides and occasionally are found between the urethra and the subpubic tissues. The opening into the urethra is usually caudad and in the lower two-thirds of the urethra; calculi are not uncommon and temporary fistulae into the vagina may occur. Diagnosis is not easy but their presence should be suspected in cases of chronic recurrent cystitis. There is sometimes dribbling of urine and palpation of the urethra may produce small amounts of urine or pus at its meatus. The urethral-vaginal septum is thickened and sometimes a definite tumour is felt, and this may be apparent to the patient, although dysuria, dyspareunia and pelvic pain are more common symptoms. Urethroscopy with a Kelly or McCarthy instrument will enable the opening of the diverticulum to be seen, and possibly the sac may be outlined with radio-opaque oil. The best treatment is surgical excision of the sac but this may be technically difficult; an aid to the dissection is the introduction into the sac of a Foley bag. The urethral opening should be sutured over an inlying catheter with fine atraumatic chromic catgut, the pubo-vesical fascia being closed over this and the vaginal mucosa treated as a separate layer. Complications are common as the technical difficulties are considerable. Some patients may be relieved of their symptoms by manual drainage and antibiotic therapy. Urethral dilatation and transurethral electrosurgical enlargement of the urethral openings are also sometimes helpful, but if at all feasible surgical excision should be attempted.

The results in 16 cases are reported. Nine had a complete excision and were cured. An additional case with diabetes recurred following incomplete excision of the sac, transurethral resection later gave partial relief. Two other patients were treated by this transurethral unroofing of the diverticulum with excellent results. The remaining 4 patients were treated by manual drainage and antibiotics.

D. C. A. Bevis

83. **Primary Melanoma of the Female Urethra.**

By M. Abrams. *J. Urol.*, **74**, 371–374. Sept. 1955.

A "caruncle" removed from a 60-year-old white woman was thought on section to be a squamous carcinoma. The patient was given local radium and deep X-ray therapy. A few months later a gland removed from the right groin was found to be a melanoma. Additional sections of the caruncle were then made and examined and they were found to be similar to those of

the gland although no melanin was present. Another gland was removed from the opposite groin and this was also melanotic. The patient was alive and well 18 months later.

Fifteen cases of melanoma of the female urethra have been reported. Most of the patients were over 50 and in two-thirds the tumour was at the distal end. The tumour is not always black or purplish in colour and the importance of careful microscopic examination of all caruncles is stressed. *J. H. Carver*

84. **Carcinoma of the Female Urethra.**

By G. E. FAGAN and A. T. HERTIG. *Obstet. Gynec.*, **6**, 1–11. July 1955. 31 refs.

Eight cases of squamous carcinoma of the female urethra are presented by the authors. The incidence is 0·016 per cent of all gynaecological malignancies. The disease is mostly seen in parous women and its aetiology is unknown. Urethral caruncle is definitely a benign lesion but may co-exist with cancer of the urethra. Symptoms are due to size of the growth, local infection and urethral obstruction, and they are present for 3–8 months before medical advice is sought. The commonest site of origin is in the urethral meatus.

The growth usually starts as a small papillomatous mass or superficial ulcer. Other malignant growths occurring in the urethra include adenocarcinoma, melanoma and sarcoma. Enlarged inguinal glands are present in 20–30 per cent of cases but the enlargement may be due to inflammation and not growth. Differential diagnosis includes caruncle, adenoma, eversion of the urethral mucosa, condyloma and varicosities.

Brack and Farber (*J. Urol.*, 1950, **64**, 710) have summarized the methods of treating the lesion as follows:

(1) Radical excision of the urethra including a portion of the vesical neck.
(2) Less radical excision.
(3) Local excision followed by irradiation.
(4) Irradiation alone.

The authors favoured irradiation treatment. The prognosis is usually poor. *J. G. Dumoulin*

85. **Stress Incontinence of Urine.**

By H. K. PACEY. *N.Z. med. J.*, **54**, 322–324. June 1955. 1 table.

The author believes that the main support of the pelvic organs is an intact muscular diaphragm. Breaches in the muscular midline raphés remove the muscular tonic support and permit prolapse in one form or other. He suggests that there is a muscular loop behind the upper urethra which is capable of lifting the urethra upwards and forwards, reducing the vesico-urethral angle and increasing the function of the bladder sphincter. Rupture of this loop allows the urethra to fall away, forming a urethrocele, which is accompanied by an increase in the vesico-urethral angle.

To cure stress incontinence it is necessary to restore the normal anatomy of the region and this can be done in the majority of cases by a careful vaginal operation which includes suturing the anterior portions of the pubococcygeus muscles in the midline behind the urethra. He reports 152 cases of vaginal repair operations for prolapse, 79 of which had stress incontinence. In 26 of the latter there had been previous plastic operations for incontinence. Seventy-four cases were seen post-operatively, 64 were cured, 6 improved and 4 unimproved. At a later date the results were: excellent 39, satisfactory 12, improved 3, and unimproved 6.

The writer suggests various causes of failure of the operation, and in cases of failure states that the treatment is to do the same operation again. In a few selected cases, however, it may be desirable to combine the second repair with some additional procedure, preferably an Aldridge type of sling. *L. Woodrow Cox*

86. **Stress Incontinence.**

By J. E. GIESEN. *N.Z. med. J.*, **54**, 325–333. June 1955. 4 figs. 1 table. 12 refs.

In this paper to the first New Zealand Congress of Obstetrics and Gynaecology, the writer briefly reviews the mechanism of bladder control and the cause of stress incontinence. He gives his experience with cases of stress incontinence which persist following a vaginal operation. He believes that the sling type of operation is too dangerous and that simple and safer operations are preferable. He gives in detail his results in 51 cases where operations were as described by Everard Williams, Mulvany, Gordon Lennon, and Marshall, Marchetti and Kranz. He favours the Mulvany and Gordon Lennon operations. Of the 51 operations, 7 were described as having a fair result, one a poor result and the remainder good results.

L. W. Cox opening the discussion gave the results for 10 years at Dunedin Hospital. In 676 cases where there was stress incontinence, utero-vaginal prolapse or both, stress incontinence was recorded in 335 cases (49·6 per cent). Failure of the operation to cure stress incontinence was recorded in 9 per cent of cases. The failure rate was higher when an anterior colporrhaphy or urethral buttressing operation was performed (19 failures in 180 cases, 10·6 per cent) and lower when anterior colporrhaphy plus amputation of the cervix or vaginal hysterectomy was performed (10 failures in 149 cases, 6·7 per cent). The writer suggests that a more thorough dissection of the fascial layers is performed when a more radical type of repair operation is done.

When a vaginal operation fails to cure stress incontinence, and the anatomical result of the operation is sound, a sling operation is suggested. A detached strip of fascia lata is passed upwards on either side of the urethra through a vaginal incision. The fascia is carried through the retropubic space with a curved forceps, the points of which are kept pressed against the pubic bone. A small transverse incision in the skin suprapubically exposes the aponeurosis of the external oblique. The ends of the fascial strip are stitched to the aponeurosis. The operation is simple and there appears to be no danger of penetrating the urethra or bladder and the tension on the strip of fascia is adjusted under direct vision.

L. Woodrow Cox

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THE JOURNAL OF OBSTETRICS AND GYNAECOLOGY OF THE BRITISH EMPIRE is published under the direction of the Royal College of Obstetricians and Gynaecologists. All business correspondence should be addressed to the *Journal of Obstetrics and Gynaecology of the British Empire*, 58 Queen Anne Street, London, W.1.

SUBSCRIPTION RATES

The Journal is published bi-monthly on or about the 21st of February, April, June, August, October, December and the Annual Subscription rates, due on 1st January, covering 1 volume (6 issues) are:

	£	s.	d.
Great Britain, Northern Ireland and Eire	3	5	0
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Remittances are payable to:

The Journal of Obstetrics and Gynaecology of the British Empire,
58 Queen Anne Street, London, W.1.

Banker's Orders should be made payable to the Journal account at Barclays Bank, Vere Street, Cavendish Square, London, W.1.

Overseas payments should be by Banker's draft payable at sight in London.

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PRINTED IN GREAT BRITAIN BY HEADLEY BROTHERS LTD
109 KINGSWAY LONDON WC2 AND ASHFORD KENT

THE JOURNAL OF OBSTETRICS AND GYNAECOLOGY OF THE BRITISH EMPIRE

Vol. LXIII FEBRUARY 1956 No. 1

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